

Reference

FM 6-300

3/S 29 August 1977

FM 6-300

FIELD MANUAL

ARMY EPHEMERIS, 1977

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HEADQUARTERS, DEPARTMENT OF THE ARMY

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Section I. INTRODUCTION

1. Purpose and Scope

a. This manual is a compilation of tables and charts for use in computing astronomical azimuths for the field artillery. These tables and charts are used for computing azimuth of the sun or selected stars by either the altitude or hour-angle method. A special table (table 12), which is a tabular method of computing Polaris, is included for a rapid computation of a Polaris azimuth. The secant tables accompanying table 12 are permanent; however, the example portion of the explanatory part of the table will be updated annually. Tables and charts are also included to correct astronomic azimuth to grid azimuth to extend azimuth by simultaneous observation and to perform zone to zone transformation of azimuth.

b. Data contained in tables 2, 10a, 10b, 11, and 12 are current only for the year in which the manual is effective. These tables are compiled annually by the Counterfire Department, US Army Field Artillery School. The basic astronomical data is

furnished by the Nautical Almanac Office, US Naval Observatory.

c. Users of this manual are encouraged to submit recommended changes or comments to improve the manual. Comments should be keyed to the specific page, paragraph, and line of the text in which the change is recommended. Reasons should be provided for each comment to insure understanding and complete evaluation. **Comments should be** prepared using DA Form 2028 (Recommended Changes to Publications and Blank Forms) and **forwarded direct to the Commandant, US Army Field Artillery School, ATT: ATSF-TD-TM, Fort Sill, Oklahoma 73503.**

2. Description of Tables and Charts

This manual is intended to be used as a companion publication to FM 6-2, Field Artillery Survey. Details on the computation of astronomical azimuth and the use of these tables and charts are contained in FM 6-2.



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Section II. ASTRONOMICAL TABLES AND CHARTS

Table 1a. Astronomic Refraction Corrected for Temperature (Degrees)

TO BE SUBTRACTED FROM OBSERVED ALTITUDE OF SUN OR STAR

(Use values of observed altitude and temperature nearest the values tabulated as arguments.)

Observed altitude	Temperature °F.																
	-30	-20	-10	0	+10	+20	+30	+40	+50	+60	+70	+80	+90	+100	+110	+120	+130
00 00	40-43	39-45	38-53	38-02	37-15	36-27	35-44	35-01	34-20	33-40	33-01	32-26	31-51	31-36	30-43	30-14	29-46
20	35-57	35-06	34-20	33-35	32-53	32-11	31-33	30-55	30-18	29-44	29-09	28-38	28-07	27-37	27-07	26-42	26-17
40	32-00	31-15	30-34	29-54	29-16	28-39	28-05	27-31	26-59	26-28	25-57	25-30	25-02	24-35	24-09	23-46	23-23
01 00	28-42	28-01	27-25	26-49	26-15	25-42	25-12	24-41	24-12	23-44	23-17	22-52	22-27	22-03	21-40	21-19	20-59
20	25-55	25-19	24-46	24-13	23-43	23-13	22-45	22-18	21-51	21-26	21-02	20-39	20-17	19-55	19-44	19-15	18-57
40	23-34	23-00	22-31	22-01	21-33	21-06	20-41	20-16	19-52	19-29	19-07	18-46	18-26	18-06	17-47	17-30	17-13
02 00	21-32	21-02	20-35	20-07	19-42	19-17	18-54	18-31	18-10	17-49	17-28	17-10	16-51	16-33	16-15	16-00	15-45
20	19-48	19-20	18-54	18-29	18-06	17-43	17-22	17-01	16-41	16-22	16-03	15-46	15-29	15-12	14-56	14-42	14-28
40	18-17	17-51	17-28	17-05	16-43	16-22	16-03	15-43	15-25	15-07	14-50	14-34	14-18	14-02	13-48	13-35	13-22
03 00	16-57	16-33	16-12	15-50	15-30	15-11	14-53	14-35	14-18	14-01	13-45	13-30	13-16	13-01	12-48	12-36	12-24
20	15-47	15-25	15-05	14-45	14-27	14-08	13-51	13-35	13-19	13-04	12-48	12-35	12-21	12-08	11-55	11-44	11-32
40	14-45	14-25	14-06	13-47	13-30	13-13	12-57	12-42	12-27	12-12	11-58	11-46	11-33	11-20	11-08	10-58	10-47
04 00	13-50	13-31	13-13	12-56	12-40	12-24	12-09	11-54	11-40	11-27	11-14	11-02	10-50	10-38	10-27	10-17	10-07
20	13-01	12-43	12-26	12-10	11-55	11-40	11-26	11-12	10-59	10-46	10-34	10-23	10-11	10-00	09-50	09-40	09-31
40	12-17	12-00	11-44	11-29	11-14	11-00	10-47	10-34	10-22	10-10	09-58	09-47	09-37	09-26	09-16	09-08	08-59
05 00	11-38	11-21	11-07	10-52	10-38	10-25	10-13	10-00	09-48	09-37	09-26	09-16	09-06	08-56	08-47	08-38	08-30
20	11-02	10-46	10-32	10-18	10-05	09-53	09-41	09-29	09-18	09-07	08-57	08-47	08-38	08-28	08-19	08-12	08-04
40	10-29	10-14	10-01	09-48	09-35	09-23	09-12	09-01	08-50	08-40	08-30	08-21	08-12	08-03	07-55	07-47	07-40
06 00	09-59	09-45	09-32	09-20	09-08	08-56	08-46	08-35	08-25	08-16	08-06	07-57	07-49	07-40	07-32	07-25	07-18
20	09-32	09-18	09-06	08-54	08-43	08-32	08-22	08-12	08-02	07-53	07-44	07-35	07-27	07-19	07-11	07-05	06-58
40	09-07	08-54	08-42	08-31	08-20	08-09	08-00	07-50	07-41	07-32	07-23	07-16	07-08	07-00	06-53	06-46	06-40
07 00	08-43	08-31	08-20	08-09	07-59	07-49	07-39	07-30	07-21	07-13	07-05	06-57	06-50	06-42	06-35	06-29	06-23
20	08-22	08-10	08-00	07-49	07-39	07-30	07-21	07-12	07-03	06-55	06-47	06-40	06-33	06-26	06-19	06-13	06-07
40	08-02	07-51	07-41	07-31	07-21	07-12	07-03	06-55	06-47	06-39	06-31	06-24	06-17	06-10	06-04	05-58	05-53
08 00	07-44	07-33	07-23	07-13	07-04	06-55	06-47	06-39	06-31	06-24	06-16	06-10	06-03	05-56	05-50	05-45	05-39
20	07-27	07-16	07-07	06-57	06-49	06-40	06-32	06-24	06-17	06-09	06-02	05-56	05-49	05-43	05-37	05-32	05-27
40	07-11	07-01	06-52	06-42	06-34	06-26	06-18	06-10	06-03	05-56	05-49	05-43	05-37	05-31	05-25	05-20	05-15
09 00	06-56	06-46	06-37	06-28	06-20	06-12	06-05	05-58	05-51	05-44	05-37	05-31	05-25	05-19	05-14	05-09	05-04
20	06-42	06-32	06-24	06-15	06-08	06-00	05-53	05-46	05-39	05-32	05-26	05-20	05-14	05-08	05-03	04-58	04-54
40	06-29	06-19	06-11	06-03	05-56	05-48	05-41	05-34	05-28	05-21	05-15	05-10	05-04	04-59	04-53	04-49	04-44
10 00	06-16	06-07	06-00	05-52	05-44	05-37	05-30	05-24	05-17	05-11	05-05	05-00	04-54	04-49	04-44	04-40	04-35
20	06-05	05-56	05-48	05-41	05-34	05-27	05-20	05-14	05-08	05-02	04-56	04-51	04-45	04-40	04-35	04-31	04-27
40	05-54	05-45	05-38	05-30	05-24	05-17	05-10	05-04	04-58	04-53	04-47	04-42	04-37	04-32	04-27	04-23	04-19
11 00	05-43	05-35	05-28	05-21	05-14	05-07	05-01	04-55	04-50	04-44	04-39	04-34	04-29	04-24	04-19	04-15	04-11
20	05-34	05-26	05-19	05-12	05-05	04-59	04-53	04-47	04-41	04-36	04-31	04-26	04-21	04-16	04-12	04-08	04-04
40	05-24	05-17	05-10	05-03	04-57	04-50	04-45	04-39	04-33	04-28	04-23	04-18	04-14	04-09	04-05	04-01	03-57
12 00	05-15	05-08	05-01	04-55	04-49	04-42	04-37	04-31	04-26	04-21	04-16	04-11	04-07	04-02	03-58	03-54	03-51
20	05-07	05-00	04-53	04-47	04-41	04-35	04-30	04-24	04-19	04-14	04-09	04-05	04-00	03-56	03-52	03-48	03-44
40	04-59	04-52	04-46	04-39	04-34	04-28	04-21	04-17	04-12	04-07	04-03	03-58	03-54	03-50	03-46	03-42	03-39

Table 1a. Astronomical Refraction Corrected for Temperature (Degrees)—Continued

Corrected altitude	Temperature °F.																
	-30	-20	-10	0	+10	+20	+30	+40	+50	+60	+70	+80	+90	+100	+110	+120	+130
13 00	04-51	04-45	04-38	04-32	04-27	04-21	04-16	04-11	04-06	04-01	03-56	03-52	03-48	03-44	03-40	03-36	03-33
20	04-44	04-37	04-31	04-25	04-20	04-14	04-09	04-04	04-00	03-55	03-50	03-46	03-42	03-38	03-34	03-31	03-27
40	04-37	04-31	04-25	04-19	04-14	04-08	04-03	03-58	03-54	03-49	03-45	03-41	03-37	03-33	03-29	03-26	03-23
14 00	04-31	04-24	04-19	04-13	04-08	04-02	03-58	03-53	03-48	03-44	03-40	03-36	03-32	03-28	03-24	03-21	03-19
20	04-24	04-18	04-12	04-07	04-02	03-57	03-52	03-47	03-43	03-39	03-34	03-31	03-27	03-23	03-19	03-16	03-13
40	04-18	04-12	04-07	04-01	03-56	03-51	03-47	03-41	03-38	03-34	03-29	03-26	03-22	03-18	03-15	03-12	03-09
15 00	04-12	04-06	04-01	03-56	03-51	03-46	03-42	03-37	03-33	03-29	03-25	03-21	03-17	03-14	03-10	03-07	03-04
20	04-07	04-01	03-56	03-51	03-46	03-41	03-37	03-32	03-28	03-24	03-20	03-17	03-13	03-10	03-06	03-03	03-00
40	04-01	03-56	03-51	03-46	03-41	03-36	03-32	03-28	03-24	03-20	03-16	03-12	03-09	03-05	03-02	02-59	02-57
16 00	03-56	03-51	03-46	03-41	03-36	03-32	03-27	03-23	03-19	03-15	03-12	03-08	03-05	03-01	02-58	02-55	02-53
20	03-51	03-46	03-41	03-36	03-32	03-27	03-23	03-19	03-15	03-12	03-08	03-04	03-01	02-58	02-55	02-52	02-49
40	03-47	03-41	03-36	03-32	03-27	03-23	03-19	03-15	03-11	03-07	03-04	03-00	02-57	02-54	02-51	02-48	02-46
17 00	03-42	03-37	03-32	03-27	03-23	03-19	03-15	03-11	03-07	03-04	03-00	02-57	02-54	02-51	02-48	02-45	02-42
20	03-38	03-32	03-28	03-23	03-19	03-15	03-11	03-07	03-03	03-00	02-56	02-53	02-50	02-47	02-44	02-42	02-39
40	03-33	03-28	03-24	03-19	03-15	03-11	03-07	03-03	03-00	02-56	02-53	02-50	02-47	02-44	02-41	02-38	02-36
18 00	03-29	03-24	03-20	03-15	03-11	03-07	03-04	03-00	02-56	02-53	02-50	02-47	02-44	02-41	02-38	02-35	02-33
20	03-25	03-20	03-16	03-12	03-08	03-04	03-00	02-56	02-53	02-50	02-46	02-43	02-41	02-38	02-35	02-32	02-30
40	03-21	03-17	03-12	03-08	03-04	03-00	02-57	02-53	02-50	02-46	02-43	02-40	02-37	02-35	02-32	02-30	02-27
19 00	03-18	03-13	03-09	03-05	03-01	02-57	02-53	02-50	02-47	02-43	02-40	02-37	02-35	02-32	02-29	02-27	02-24
20	03-14	03-09	03-05	03-01	02-58	02-54	02-50	02-47	02-44	02-40	02-37	02-35	02-32	02-29	02-26	02-24	02-22
40	03-10	03-06	03-02	02-58	02-54	02-51	02-47	02-44	02-41	02-38	02-34	02-32	02-29	02-26	02-24	02-21	02-19
20 00	03-07	03-03	02-59	02-55	02-51	02-48	02-44	02-41	02-38	02-35	02-32	02-29	02-26	02-24	02-21	02-19	02-17
20	03-04	02-59	02-56	02-52	02-48	02-45	02-41	02-38	02-35	02-32	02-29	02-26	02-24	02-21	02-19	02-17	02-14
40	03-01	02-56	02-53	02-49	02-45	02-42	02-39	02-35	02-32	02-29	02-27	02-24	02-21	02-19	02-16	02-14	02-12
21 00	02-58	02-53	02-50	02-46	02-42	02-39	02-36	02-33	02-30	02-27	02-24	02-21	02-19	02-16	02-14	02-12	02-10
20	02-55	02-50	02-47	02-43	02-40	02-36	02-33	02-30	02-27	02-24	02-22	02-19	02-17	02-14	02-12	02-10	02-08
40	02-52	02-48	02-44	02-40	02-37	02-34	02-31	02-28	02-25	02-22	02-19	02-17	02-14	02-12	02-10	02-07	02-05
22 00	02-49	02-45	02-41	02-38	02-34	02-31	02-28	02-25	02-22	02-20	02-17	02-14	02-12	02-10	02-07	02-05	02-03
20	02-46	02-42	02-39	02-35	02-32	02-29	02-26	02-23	02-20	02-17	02-15	02-12	02-10	02-08	02-05	02-03	02-01
40	02-43	02-40	02-36	02-33	02-30	02-26	02-23	02-21	02-18	02-15	02-13	02-10	02-08	02-06	02-03	02-01	01-59
23 00	02-41	02-37	02-34	02-30	02-27	02-24	02-21	02-18	02-16	02-13	02-10	02-08	02-06	02-04	02-01	01-59	01-58
20	02-38	02-34	02-31	02-28	02-25	02-22	02-19	02-16	02-13	02-11	02-08	02-06	02-04	02-02	01-59	01-58	01-56
40	02-35	02-32	02-29	02-26	02-23	02-20	02-17	02-14	02-11	02-09	02-06	02-04	02-02	02-00	01-58	01-56	01-54
24 00	02-33	02-30	02-26	02-23	02-20	02-17	02-15	02-12	02-09	02-07	02-04	02-02	02-00	01-58	01-56	01-54	01-52
20	02-31	02-28	02-24	02-21	02-18	02-15	02-13	02-10	02-07	02-05	02-03	02-00	01-58	01-56	01-54	01-52	01-50
40	02-29	02-25	02-22	02-19	02-16	02-13	02-11	02-08	02-05	02-03	02-01	01-59	01-56	01-54	01-52	01-50	01-49
25 00	02-28	02-23	02-20	02-17	02-14	02-11	02-09	02-06	02-04	02-01	01-59	01-57	01-55	01-53	01-51	01-49	01-47
20	02-24	02-21	02-18	02-15	02-12	02-09	02-07	02-04	02-02	02-00	01-57	01-55	01-53	01-51	01-49	01-47	01-46
40	02-22	02-19	02-16	02-13	02-10	02-07	02-05	02-02	02-00	01-58	01-55	01-53	01-51	01-49	01-47	01-46	01-44
26 00	02-20	02-17	02-14	02-11	02-08	02-06	02-03	02-01	01-58	01-56	01-54	01-52	01-50	01-48	01-46	01-44	01-42
20	02-18	02-15	02-12	02-09	02-06	02-04	02-01	01-59	01-56	01-54	01-52	01-50	01-48	01-46	01-44	01-43	01-41
40	02-16	02-13	02-10	02-07	02-05	02-02	02-00	01-57	01-55	01-53	01-50	01-48	01-47	01-45	01-43	01-41	01-40

Table 1a. Astronomic Refraction Corrected for Temperature (Degrees)—Continued

Observed altitude		Temperature °F.																
		-30	-20	-10	0	+10	+20	+30	+40	+50	+60	+70	+80	+90	+100	+110	+120	+130
°	'	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
27	00	02-14	02-11	02-08	02-05	02-03	02-00	01-58	01-55	01-53	01-51	01-49	01-47	01-45	01-43	01-41	01-40	01-38
	20	02-12	02-09	02-06	02-04	02-01	01-59	01-56	01-54	01-52	01-49	01-47	01-45	01-44	01-42	01-40	01-38	01-37
	40	02-10	02-07	02-05	02-02	01-59	01-57	01-55	01-52	01-50	01-48	01-46	01-44	01-42	01-40	01-38	01-37	01-35
28	00	02-09	02-06	02-03	02-00	01-58	01-55	01-53	01-51	01-48	01-46	01-44	01-43	01-41	01-39	01-37	01-36	01-34
	20	02-07	02-04	02-01	01-59	01-56	01-54	01-51	01-49	01-47	01-45	01-43	01-41	01-39	01-37	01-36	01-34	01-33
	40	02-05	02-02	02-00	01-57	01-54	01-52	01-50	01-48	01-46	01-43	01-41	01-40	01-38	01-36	01-34	01-33	01-31
29	00	02-03	02-01	01-58	01-55	01-53	01-51	01-48	01-46	01-44	01-42	01-40	01-38	01-37	01-35	01-33	01-32	01-30
	20	02-02	01-59	01-56	01-54	01-51	01-49	01-47	01-45	01-43	01-41	01-39	01-37	01-35	01-34	01-32	01-30	01-29
	40	02-00	01-57	01-55	01-52	01-50	01-48	01-45	01-43	01-41	01-39	01-37	01-36	01-34	01-32	01-31	01-29	01-28
30	00	01-59	01-56	01-53	01-51	01-48	01-46	01-44	01-42	01-40	01-38	01-36	01-34	01-33	01-31	01-30	01-28	01-27
	20	01-57	01-54	01-52	01-49	01-47	01-45	01-43	01-41	01-39	01-37	01-35	01-33	01-32	01-30	01-28	01-27	01-25
	40	01-55	01-53	01-50	01-48	01-46	01-43	01-41	01-39	01-37	01-36	01-34	01-32	01-30	01-29	01-27	01-26	01-24
31	00	01-54	01-51	01-49	01-46	01-44	01-42	01-40	01-38	01-36	01-34	01-32	01-31	01-29	01-28	01-26	01-25	01-23
	20	01-52	01-50	01-47	01-45	01-43	01-41	01-39	01-37	01-35	01-33	01-31	01-30	01-28	01-26	01-25	01-24	01-22
	40	01-51	01-48	01-46	01-44	01-42	01-39	01-37	01-35	01-34	01-32	01-30	01-28	01-27	01-25	01-24	01-22	01-21
32	00	01-50	01-47	01-45	01-42	01-40	01-38	01-36	01-34	01-32	01-31	01-29	01-27	01-26	01-24	01-23	01-21	01-20
	30	01-48	01-45	01-43	01-40	01-38	01-36	01-34	01-33	01-31	01-29	01-27	01-26	01-24	01-23	01-21	01-20	01-19
33	00	01-45	01-43	01-41	01-39	01-36	01-34	01-33	01-31	01-29	01-27	01-26	01-24	01-22	01-21	01-20	01-18	01-17
	30	01-44	01-41	01-39	01-37	01-35	01-33	01-31	01-29	01-27	01-26	01-24	01-22	01-21	01-20	01-18	01-17	01-16
34	00	01-42	01-39	01-37	01-35	01-33	01-31	01-29	01-27	01-26	01-24	01-22	01-21	01-19	01-18	01-17	01-15	01-14
	30	01-40	01-37	01-35	01-33	01-31	01-29	01-28	01-26	01-24	01-23	01-21	01-19	01-18	01-17	01-15	01-14	01-13
35	00	01-38	01-36	01-33	01-31	01-30	01-28	01-26	01-24	01-22	01-21	01-19	01-18	01-17	01-15	01-14	01-13	01-12
	30	01-36	01-34	01-32	01-30	01-28	01-26	01-24	01-23	01-21	01-19	01-18	01-17	01-15	01-14	01-12	01-11	01-10
36	00	01-34	01-32	01-30	01-28	01-26	01-24	01-23	01-21	01-20	01-18	01-16	01-15	01-14	01-12	01-11	01-10	01-09
	30	01-33	01-30	01-28	01-27	01-25	01-23	01-21	01-20	01-18	01-17	01-15	01-14	01-12	01-11	01-10	01-09	01-08
37	00	01-31	01-29	01-27	01-25	01-23	01-21	01-20	01-18	01-17	01-15	01-14	01-12	01-11	01-10	01-09	01-08	01-06
	30	01-29	01-27	01-25	01-23	01-22	01-20	01-18	01-17	01-15	01-14	01-12	01-11	01-10	01-09	01-07	01-06	01-05
38	00	01-28	01-26	01-24	01-22	01-20	01-19	01-17	01-15	01-14	01-13	01-11	01-10	01-09	01-07	01-06	01-05	01-04
	30	01-26	01-24	01-22	01-21	01-19	01-17	01-16	01-14	01-13	01-11	01-10	01-09	01-07	01-06	01-05	01-04	01-03
39	00	01-25	01-23	01-21	01-19	01-17	01-16	01-14	01-13	01-11	01-10	01-09	01-07	01-06	01-05	01-04	01-03	01-02
	30	01-23	01-21	01-19	01-18	01-16	01-14	01-13	01-12	01-10	01-09	01-07	01-06	01-05	01-04	01-03	01-02	01-01
40	00	01-22	01-20	01-18	01-16	01-15	01-13	01-12	01-10	01-09	01-08	01-06	01-05	01-04	01-03	01-02	01-01	01-00
	30	01-20	01-18	01-17	01-15	01-13	01-12	01-10	01-09	01-08	01-06	01-05	01-04	01-03	01-02	01-01	01-00	00-59
41	00	01-19	01-17	01-15	01-14	01-12	01-11	01-09	01-09	01-06	01-05	01-04	01-03	01-02	01-01	01-00	00-59	00-58
	30	01-18	01-16	01-14	01-12	01-11	01-09	01-08	01-07	01-05	01-04	01-03	01-02	01-01	01-00	00-59	00-58	00-57
42	00	01-16	01-14	01-13	01-11	01-10	01-08	01-07	01-05	01-04	01-03	01-02	01-01	01-00	00-58	00-57	00-57	00-56
	30	01-15	01-13	01-11	01-10	01-08	01-07	01-06	01-04	01-03	01-02	01-01	01-00	00-59	00-57	00-56	00-56	00-55
43	00	01-14	01-12	01-10	01-09	01-07	01-06	01-05	01-03	01-02	01-01	01-00	00-59	00-58	00-56	00-55	00-55	00-54
	30	01-12	01-11	01-09	01-08	01-06	01-05	01-04	01-02	01-01	01-00	00-59	00-58	00-57	00-56	00-55	00-54	00-53

Table 1a. Astronomic Refraction Corrected for Temperature (Degrees)—Continued

Observed altitude	Temperature °F.																
	-30	-20	-10	0	+10	+20	+30	+40	+50	+60	+70	+80	+90	+100	+110	+120	+130
44 00	01-11	01-09	01-08	01-06	01-05	01-04	01-02	01-01	01-00	00-59	00-58	00-57	00-56	00-55	00-54	00-53	00-52
44 30	01-10	01-08	01-07	01-05	01-04	01-03	01-01	01-00	00-59	00-58	00-57	00-56	00-55	00-54	00-53	00-52	00-51
45 00	01-09	01-07	01-06	01-04	01-03	01-01	01-00	00-59	00-58	00-57	00-56	00-55	00-54	00-53	00-52	00-51	00-50
45 30	01-07	01-06	01-04	01-03	01-02	01-00	00-59	00-58	00-57	00-56	00-55	00-54	00-53	00-52	00-51	00-50	00-49
46 00	01-06	01-05	01-03	01-02	01-01	00-59	00-58	00-57	00-56	00-55	00-54	00-53	00-52	00-51	00-50	00-49	00-48
46 30	01-05	01-04	01-02	01-01	01-00	00-58	00-57	00-56	00-55	00-54	00-53	00-52	00-51	00-50	00-49	00-48	00-48
47 00	01-04	01-03	01-01	01-00	00-59	00-57	00-56	00-55	00-54	00-53	00-52	00-51	00-50	00-49	00-48	00-48	00-47
47 30	01-03	01-01	01-00	00-59	00-58	00-56	00-55	00-54	00-53	00-52	00-51	00-50	00-49	00-48	00-47	00-47	00-46
48 00	01-02	01-00	00-59	00-58	00-57	00-55	00-54	00-53	00-52	00-51	00-50	00-49	00-48	00-47	00-47	00-46	00-45
48 30	01-01	00-59	00-58	00-57	00-56	00-54	00-53	00-52	00-51	00-50	00-49	00-48	00-48	00-47	00-46	00-45	00-44
49 00	01-00	00-58	00-57	00-56	00-55	00-53	00-52	00-51	00-50	00-49	00-48	00-48	00-47	00-46	00-45	00-44	00-44
49 30	00-59	00-57	00-56	00-55	00-54	00-52	00-51	00-50	00-49	00-48	00-48	00-47	00-46	00-45	00-44	00-44	00-43
50 00	00-58	00-56	00-55	00-54	00-53	00-52	00-51	00-50	00-49	00-48	00-47	00-46	00-45	00-44	00-43	00-43	00-42
51 00	00-56	00-54	00-53	00-52	00-51	00-50	00-49	00-48	00-47	00-46	00-45	00-44	00-44	00-43	00-42	00-41	00-41
52 00	00-54	00-52	00-51	00-50	00-49	00-48	00-47	00-46	00-45	00-44	00-43	00-43	00-42	00-41	00-40	00-40	00-39
53 00	00-52	00-50	00-49	00-48	00-47	00-46	00-45	00-44	00-44	00-43	00-42	00-41	00-40	00-40	00-39	00-38	00-38
54 00	00-50	00-49	00-48	00-47	00-46	00-45	00-44	00-43	00-42	00-41	00-41	00-40	00-39	00-38	00-38	00-37	00-37
55 00	00-48	00-47	00-46	00-45	00-44	00-43	00-42	00-41	00-40	00-40	00-39	00-38	00-38	00-37	00-36	00-36	00-35
56 00	00-46	00-45	00-44	00-43	00-42	00-41	00-41	00-40	00-39	00-38	00-38	00-37	00-36	00-36	00-35	00-34	00-34
57 00	00-45	00-44	00-43	00-42	00-41	00-40	00-39	00-38	00-38	00-37	00-36	00-36	00-35	00-34	00-34	00-33	00-33
58 00	00-43	00-42	00-41	00-40	00-39	00-38	00-38	00-37	00-36	00-36	00-35	00-34	00-34	00-33	00-32	00-32	00-31
59 00	00-41	00-40	00-39	00-39	00-38	00-37	00-36	00-35	00-35	00-34	00-33	00-33	00-32	00-32	00-31	00-31	00-30
60 00	00-40	00-39	00-38	00-37	00-36	00-35	00-35	00-34	00-33	00-33	00-32	00-32	00-31	00-30	00-30	00-29	00-29

Table 1b. Astronomic Refraction Corrected for Temperature (Mils)

TO BE SUBTRACTED FROM OBSERVED ALTITUDE OF SUN OR STAR

(Use values of observed altitude and temperature nearest the values tabulated as arguments.)

Observed altitude	Temperature °F.																
	-30	-20	-10	0	+10	+20	+30	+40	+50	+60	+70	+80	+90	+100	+110	+120	+130
0	12.65	12.35	12.08	11.82	11.57	11.33	11.10	10.88	10.66	10.46	10.26	10.08	9.90	9.72	9.54	9.40	9.25
10	9.83	9.60	9.39	9.18	8.99	8.80	8.63	8.45	8.29	8.13	7.97	7.83	7.69	7.55	7.42	7.30	7.19
20	8.18	7.99	7.82	7.64	7.49	7.33	7.21	7.04	6.90	6.77	6.64	6.52	6.40	6.28	6.17	6.08	5.98
30	6.94	6.78	6.63	6.49	6.35	6.22	6.09	5.97	5.85	5.74	5.63	5.53	5.43	5.33	5.24	5.16	5.08
40	5.99	5.85	5.72	5.60	5.48	5.36	5.26	5.15	5.05	4.95	4.86	4.77	4.69	4.60	4.52	4.45	4.38
50	5.24	5.11	5.00	4.89	4.79	4.69	4.60	4.50	4.42	4.33	4.25	4.17	4.10	4.02	3.95	3.89	3.83
60	4.64	4.53	4.43	4.33	4.24	4.15	4.07	3.99	3.91	3.84	3.76	3.70	3.63	3.56	3.50	3.45	3.39
70	4.15	4.05	3.96	3.88	3.80	3.72	3.64	3.57	3.50	3.43	3.37	3.31	3.25	3.19	3.13	3.08	3.03
80	3.75	3.66	3.58	3.50	3.43	3.35	3.29	3.22	3.16	3.10	3.04	2.99	2.93	2.88	2.83	2.78	2.74
90	3.41	3.33	3.26	3.19	3.12	3.06	2.99	2.93	2.88	2.82	2.77	2.72	2.67	2.62	2.57	2.53	2.46
100	3.13	3.05	2.99	2.92	2.86	2.80	2.74	2.69	2.64	2.59	2.54	2.49	2.45	2.40	2.36	2.32	2.28
110	2.88	2.81	2.75	2.69	2.64	2.58	2.53	2.48	2.43	2.38	2.34	2.30	2.25	2.21	2.17	2.14	2.11
120	2.67	2.61	2.55	2.49	2.44	2.39	2.34	2.30	2.25	2.21	2.17	2.13	2.09	2.05	2.01	1.98	1.95
130	2.49	2.43	2.37	2.32	2.27	2.22	2.18	2.14	2.10	2.06	2.02	1.98	1.94	1.91	1.88	1.85	1.82
140	2.32	2.27	2.22	2.17	2.13	2.08	2.04	2.00	1.96	1.92	1.88	1.85	1.82	1.79	1.75	1.73	1.70
150	2.18	2.13	2.08	2.04	2.00	1.95	1.91	1.88	1.84	1.80	1.77	1.74	1.71	1.68	1.65	1.62	1.59
160	2.05	2.00	1.96	1.92	1.88	1.84	1.80	1.77	1.73	1.70	1.67	1.64	1.61	1.58	1.55	1.53	1.50
170	1.94	1.89	1.85	1.81	1.77	1.74	1.70	1.67	1.64	1.60	1.57	1.55	1.52	1.49	1.46	1.44	1.42
180	1.84	1.79	1.75	1.72	1.68	1.64	1.61	1.58	1.55	1.52	1.49	1.46	1.44	1.41	1.39	1.36	1.34
190	1.74	1.70	1.67	1.63	1.59	1.56	1.53	1.50	1.47	1.44	1.41	1.39	1.36	1.34	1.32	1.29	1.27
200	1.66	1.62	1.58	1.55	1.52	1.49	1.46	1.43	1.40	1.37	1.35	1.32	1.30	1.27	1.25	1.23	1.21
210	1.58	1.54	1.51	1.48	1.45	1.42	1.39	1.36	1.33	1.31	1.28	1.26	1.24	1.22	1.19	1.18	1.16
220	1.51	1.48	1.44	1.41	1.38	1.35	1.33	1.30	1.27	1.25	1.23	1.20	1.18	1.16	1.14	1.12	1.10
230	1.45	1.41	1.38	1.35	1.32	1.29	1.27	1.25	1.22	1.20	1.17	1.15	1.13	1.11	1.09	1.07	1.06
240	1.39	1.35	1.32	1.29	1.27	1.24	1.22	1.19	1.17	1.15	1.12	1.10	1.08	1.06	1.05	1.03	1.01
250	1.33	1.30	1.27	1.24	1.22	1.19	1.17	1.14	1.12	1.10	1.08	1.06	1.04	1.02	1.00	0.99	0.97
260	1.28	1.25	1.22	1.19	1.17	1.14	1.12	1.10	1.08	1.06	1.04	1.02	1.00	0.98	0.96	0.95	0.93
270	1.23	1.20	1.18	1.15	1.13	1.10	1.08	1.06	1.04	1.02	0.99	0.98	0.96	0.95	0.93	0.91	0.90
280	1.19	1.16	1.13	1.11	1.09	1.06	1.04	1.02	1.00	0.98	0.96	0.94	0.93	0.91	0.90	0.88	0.87
290	1.14	1.12	1.09	1.07	1.05	1.02	1.00	0.98	0.96	0.95	0.93	0.91	0.89	0.88	0.86	0.85	0.84
300	1.10	1.08	1.06	1.03	1.01	0.99	0.97	0.95	0.93	0.91	0.90	0.88	0.86	0.85	0.83	0.82	0.81
310	1.07	1.04	1.02	1.00	0.98	0.96	0.94	0.92	0.90	0.88	0.87	0.85	0.84	0.82	0.81	0.79	0.78
320	1.03	1.01	0.99	0.96	0.94	0.92	0.91	0.89	0.87	0.85	0.84	0.82	0.81	0.79	0.78	0.77	0.75
330	1.00	0.98	0.96	0.93	0.92	0.90	0.88	0.86	0.84	0.83	0.81	0.80	0.78	0.77	0.75	0.74	0.73
340	0.97	0.95	0.93	0.91	0.89	0.87	0.85	0.83	0.82	0.80	0.79	0.77	0.76	0.74	0.73	0.72	0.71

Table 1b. Astronomic Refraction Corrected for Temperature (Mils)—Continued

Observed altitude	Temperature °F.																
	-30	-20	-10	0	+10	+20	+30	+40	+50	+60	+70	+80	+90	+100	+110	+120	+130
350	0.94	0.92	0.90	0.88	0.86	0.84	0.82	0.81	0.79	0.78	0.76	0.75	0.74	0.72	0.71	0.70	0.69
360	0.91	0.89	0.87	0.85	0.83	0.82	0.80	0.78	0.77	0.75	0.74	0.73	0.71	0.70	0.69	0.68	0.67
370	0.89	0.86	0.85	0.83	0.81	0.79	0.78	0.76	0.75	0.73	0.72	0.71	0.69	0.68	0.67	0.66	0.65
380	0.86	0.84	0.82	0.80	0.79	0.77	0.76	0.74	0.73	0.71	0.70	0.69	0.67	0.66	0.65	0.64	0.63
390	0.84	0.82	0.80	0.78	0.77	0.75	0.73	0.72	0.71	0.69	0.68	0.67	0.65	0.64	0.63	0.62	0.61
400	0.81	0.79	0.78	0.76	0.74	0.73	0.71	0.70	0.69	0.67	0.66	0.65	0.64	0.62	0.61	0.60	0.59
410	0.79	0.77	0.76	0.74	0.72	0.71	0.70	0.68	0.67	0.65	0.64	0.63	0.62	0.61	0.60	0.59	0.58
420	0.77	0.75	0.74	0.72	0.71	0.69	0.68	0.66	0.65	0.64	0.63	0.61	0.60	0.59	0.58	0.57	0.56
430	0.75	0.73	0.72	0.70	0.69	0.67	0.66	0.65	0.63	0.62	0.61	0.60	0.59	0.58	0.57	0.56	0.55
440	0.73	0.71	0.70	0.68	0.67	0.66	0.64	0.63	0.62	0.61	0.59	0.58	0.57	0.56	0.55	0.54	0.54
450	0.71	0.70	0.68	0.67	0.65	0.64	0.63	0.61	0.60	0.59	0.58	0.57	0.56	0.55	0.54	0.53	0.52
460	0.70	0.68	0.66	0.65	0.64	0.62	0.61	0.60	0.59	0.58	0.56	0.55	0.54	0.53	0.53	0.52	0.51
470	0.68	0.66	0.65	0.64	0.62	0.61	0.60	0.58	0.57	0.56	0.55	0.54	0.53	0.52	0.51	0.50	0.50
480	0.66	0.65	0.63	0.62	0.61	0.59	0.58	0.57	0.56	0.55	0.54	0.53	0.52	0.51	0.50	0.49	0.48
490	0.65	0.63	0.62	0.60	0.59	0.58	0.57	0.56	0.55	0.54	0.52	0.52	0.51	0.50	0.49	0.48	0.47
500	0.63	0.62	0.60	0.59	0.58	0.57	0.55	0.54	0.53	0.52	0.51	0.50	0.49	0.49	0.48	0.47	0.46
510	0.62	0.62	0.59	0.58	0.56	0.55	0.54	0.53	0.52	0.51	0.50	0.49	0.48	0.47	0.47	0.46	0.45
520	0.60	0.59	0.58	0.56	0.55	0.54	0.53	0.52	0.51	0.50	0.49	0.48	0.47	0.46	0.46	0.45	0.44
530	0.59	0.58	0.56	0.55	0.54	0.53	0.52	0.51	0.50	0.49	0.48	0.47	0.46	0.45	0.45	0.44	0.43
540	0.58	0.56	0.55	0.54	0.53	0.52	0.51	0.50	0.49	0.48	0.47	0.46	0.45	0.44	0.43	0.43	0.42
550	0.56	0.55	0.54	0.53	0.52	0.51	0.50	0.49	0.48	0.47	0.46	0.45	0.44	0.43	0.42	0.42	0.41
560	0.55	0.54	0.53	0.52	0.50	0.49	0.48	0.47	0.47	0.46	0.45	0.44	0.43	0.42	0.42	0.41	0.40
570	0.54	0.53	0.52	0.50	0.49	0.48	0.47	0.46	0.46	0.45	0.44	0.43	0.42	0.41	0.41	0.40	0.39
580	0.53	0.52	0.50	0.49	0.48	0.47	0.46	0.45	0.45	0.44	0.43	0.42	0.41	0.41	0.40	0.39	0.39
590	0.52	0.50	0.49	0.48	0.47	0.46	0.45	0.44	0.44	0.43	0.42	0.41	0.40	0.40	0.39	0.38	0.38
600	0.51	0.49	0.48	0.47	0.46	0.45	0.44	0.44	0.43	0.42	0.41	0.40	0.40	0.39	0.38	0.38	0.37
610	0.50	0.48	0.47	0.46	0.45	0.44	0.44	0.43	0.42	0.41	0.40	0.40	0.39	0.38	0.37	0.37	0.36
620	0.49	0.47	0.46	0.45	0.44	0.43	0.43	0.42	0.41	0.40	0.39	0.39	0.38	0.37	0.37	0.36	0.35
630	0.48	0.46	0.45	0.44	0.44	0.43	0.42	0.41	0.40	0.39	0.39	0.38	0.37	0.37	0.36	0.35	0.35
640	0.47	0.45	0.44	0.43	0.43	0.42	0.41	0.40	0.39	0.39	0.38	0.37	0.36	0.36	0.35	0.35	0.34
650	0.46	0.45	0.44	0.43	0.42	0.41	0.40	0.39	0.38	0.38	0.37	0.36	0.36	0.35	0.34	0.34	0.33
660	0.45	0.44	0.43	0.42	0.41	0.40	0.39	0.38	0.38	0.37	0.36	0.36	0.35	0.34	0.34	0.33	0.33
670	0.44	0.43	0.42	0.41	0.40	0.39	0.38	0.38	0.37	0.36	0.36	0.35	0.34	0.34	0.33	0.33	0.32
680	0.43	0.42	0.41	0.40	0.39	0.39	0.38	0.37	0.36	0.36	0.35	0.34	0.34	0.33	0.32	0.32	0.31
690	0.42	0.41	0.40	0.39	0.39	0.38	0.37	0.36	0.36	0.35	0.34	0.34	0.33	0.32	0.32	0.31	0.31
700	0.41	0.40	0.39	0.39	0.38	0.37	0.36	0.36	0.35	0.34	0.33	0.33	0.32	0.32	0.31	0.31	0.30
710	0.40	0.40	0.39	0.38	0.37	0.36	0.36	0.35	0.34	0.33	0.33	0.32	0.32	0.31	0.31	0.30	0.30
720	0.40	0.39	0.38	0.37	0.36	0.36	0.35	0.34	0.33	0.33	0.32	0.32	0.31	0.30	0.30	0.29	0.29
730	0.39	0.38	0.37	0.36	0.36	0.35	0.34	0.33	0.33	0.32	0.31	0.31	0.30	0.30	0.29	0.29	0.28
740	0.38	0.37	0.36	0.36	0.35	0.34	0.33	0.33	0.32	0.32	0.31	0.30	0.30	0.29	0.29	0.28	0.28
750	0.37	0.36	0.36	0.35	0.34	0.33	0.33	0.32	0.32	0.31	0.30	0.30	0.29	0.29	0.28	0.28	0.27

Table 1b. Astronomic Refraction Corrected for Temperature (Mils)—Continued

Observed altitude	Temperature °F.																
	-30	-20	-10	0	+10	+20	+30	+40	+50	+60	+70	+80	+90	+100	+110	+120	+130
760	0.37	0.36	0.35	0.34	0.34	0.33	0.32	0.32	0.31	0.30	0.30	0.29	0.29	0.28	0.28	0.27	0.27
770	0.36	0.35	0.34	0.34	0.33	0.32	0.32	0.31	0.30	0.30	0.29	0.29	0.28	0.28	0.27	0.27	0.26
780	0.35	0.34	0.34	0.33	0.32	0.32	0.31	0.30	0.30	0.29	0.29	0.28	0.28	0.27	0.27	0.26	0.26
790	0.35	0.34	0.33	0.32	0.32	0.31	0.30	0.30	0.29	0.29	0.28	0.28	0.27	0.27	0.26	0.26	0.25
800	0.34	0.33	0.32	0.32	0.31	0.30	0.30	0.29	0.29	0.28	0.28	0.27	0.27	0.26	0.26	0.25	0.25
810	0.33	0.32	0.32	0.31	0.30	0.30	0.29	0.29	0.28	0.27	0.27	0.26	0.26	0.26	0.25	0.25	0.24
820	0.33	0.32	0.31	0.30	0.30	0.29	0.29	0.28	0.27	0.27	0.26	0.26	0.25	0.25	0.25	0.24	0.24
830	0.32	0.31	0.31	0.30	0.29	0.29	0.28	0.28	0.27	0.26	0.26	0.25	0.25	0.25	0.24	0.24	0.23
840	0.31	0.31	0.30	0.29	0.29	0.28	0.27	0.27	0.26	0.26	0.25	0.25	0.24	0.24	0.24	0.23	0.23
850	0.31	0.30	0.29	0.29	0.28	0.27	0.27	0.26	0.26	0.25	0.25	0.24	0.24	0.24	0.23	0.23	0.22
860	0.30	0.29	0.29	0.28	0.28	0.27	0.26	0.26	0.25	0.25	0.24	0.24	0.24	0.23	0.23	0.22	0.22
870	0.30	0.29	0.28	0.28	0.27	0.26	0.26	0.25	0.25	0.24	0.24	0.24	0.23	0.23	0.22	0.22	0.22
880	0.29	0.28	0.28	0.27	0.26	0.25	0.25	0.25	0.24	0.24	0.23	0.23	0.23	0.22	0.22	0.21	0.21
890	0.28	0.28	0.27	0.27	0.26	0.25	0.25	0.24	0.24	0.23	0.23	0.23	0.22	0.22	0.21	0.21	0.21
900	0.28	0.27	0.27	0.26	0.25	0.25	0.24	0.24	0.23	0.23	0.23	0.22	0.22	0.21	0.21	0.21	0.20
910	0.27	0.27	0.26	0.25	0.25	0.24	0.24	0.23	0.23	0.23	0.22	0.22	0.21	0.21	0.21	0.20	0.20
920	0.27	0.26	0.26	0.25	0.24	0.24	0.23	0.23	0.23	0.22	0.22	0.21	0.21	0.21	0.20	0.20	0.20
930	0.26	0.26	0.25	0.24	0.24	0.23	0.23	0.23	0.22	0.22	0.21	0.21	0.20	0.20	0.20	0.19	0.19
940	0.26	0.25	0.25	0.24	0.24	0.23	0.23	0.22	0.22	0.21	0.21	0.20	0.20	0.20	0.19	0.19	0.19
950	0.25	0.25	0.24	0.23	0.23	0.22	0.22	0.22	0.21	0.21	0.20	0.20	0.20	0.19	0.19	0.19	0.18
960	0.25	0.24	0.24	0.23	0.23	0.22	0.22	0.21	0.21	0.20	0.20	0.20	0.19	0.19	0.19	0.18	0.18
970	0.24	0.24	0.23	0.23	0.22	0.22	0.21	0.21	0.20	0.20	0.20	0.19	0.19	0.19	0.18	0.18	0.18
980	0.24	0.23	0.23	0.22	0.22	0.21	0.21	0.20	0.20	0.20	0.19	0.19	0.19	0.18	0.18	0.18	0.17
990	0.23	0.23	0.22	0.22	0.21	0.21	0.20	0.20	0.20	0.19	0.19	0.18	0.18	0.18	0.17	0.17	0.17
1000	0.23	0.22	0.22	0.21	0.21	0.20	0.20	0.19	0.19	0.19	0.18	0.18	0.18	0.17	0.17	0.17	0.17
1010	0.22	0.22	0.21	0.21	0.20	0.20	0.19	0.19	0.19	0.18	0.18	0.18	0.17	0.17	0.17	0.16	0.16
1020	0.22	0.21	0.21	0.20	0.20	0.19	0.19	0.19	0.18	0.18	0.18	0.17	0.17	0.17	0.16	0.16	0.16
1030	0.21	0.21	0.20	0.20	0.19	0.19	0.19	0.18	0.18	0.18	0.17	0.17	0.17	0.16	0.16	0.16	0.16
1040	0.21	0.20	0.20	0.19	0.19	0.19	0.18	0.18	0.18	0.17	0.17	0.17	0.16	0.16	0.16	0.15	0.15
1050	0.20	0.20	0.19	0.19	0.19	0.18	0.18	0.17	0.17	0.17	0.16	0.16	0.16	0.15	0.15	0.15	0.15
1060	0.20	0.19	0.19	0.19	0.18	0.18	0.17	0.17	0.17	0.16	0.16	0.16	0.16	0.15	0.15	0.15	0.15
1070	0.19	0.19	0.19	0.18	0.18	0.17	0.17	0.17	0.16	0.16	0.16	0.15	0.15	0.15	0.15	0.14	0.14
1080	0.19	0.19	0.18	0.18	0.17	0.17	0.17	0.16	0.16	0.16	0.15	0.15	0.15	0.15	0.14	0.14	0.14
1090	0.19	0.18	0.18	0.17	0.17	0.17	0.16	0.16	0.16	0.15	0.15	0.15	0.15	0.14	0.14	0.14	0.14
1100	0.18	0.18	0.17	0.17	0.17	0.16	0.16	0.16	0.15	0.15	0.15	0.14	0.14	0.14	0.14	0.13	0.13
1110	0.18	0.17	0.17	0.17	0.16	0.16	0.16	0.15	0.15	0.15	0.14	0.14	0.14	0.14	0.13	0.13	0.13
1120	0.17	0.17	0.17	0.16	0.16	0.15	0.15	0.15	0.15	0.14	0.14	0.14	0.14	0.13	0.13	0.13	0.13
1130	0.17	0.16	0.16	0.16	0.15	0.15	0.15	0.15	0.14	0.14	0.14	0.13	0.13	0.13	0.13	0.13	0.12
1140	0.16	0.16	0.16	0.15	0.15	0.15	0.14	0.14	0.14	0.14	0.13	0.13	0.13	0.13	0.12	0.12	0.12
1150	0.16	0.16	0.15	0.15	0.15	0.14	0.14	0.14	0.14	0.13	0.13	0.13	0.13	0.12	0.12	0.12	0.12
1160	0.16	0.15	0.15	0.15	0.14	0.14	0.14	0.13	0.13	0.13	0.13	0.12	0.12	0.12	0.12	0.12	0.11
1170	0.15	0.15	0.15	0.14	0.14	0.14	0.13	0.13	0.13	0.13	0.12	0.12	0.12	0.12	0.11	0.11	0.11
1180	0.15	0.15	0.14	0.14	0.14	0.13	0.13	0.13	0.13	0.12	0.12	0.12	0.12	0.11	0.11	0.11	0.11
1190	0.14	0.14	0.14	0.14	0.13	0.13	0.13	0.12	0.12	0.12	0.12	0.12	0.11	0.11	0.11	0.11	0.11
1200	0.14	0.14	0.13	0.13	0.13	0.13	0.12	0.12	0.12	0.12	0.11	0.11	0.11	0.11	0.11	0.10	0.10

Table 1c. Pressure Correction Factor, C_B
 Apply to values in tables 1a or 1b

Barometer		C_B	Barometer		C_B	Barometer		C_B
Inches	Millibars		Inches	Millibars		Inches	Millibars	
20.0	677	0.670	23.8	806	0.796	27.4	928	0.916
20.1	681	0.673	23.9	809	0.799	27.5	931	0.920
20.2	684	0.676				27.6	935	0.923
20.3	687	0.679	23.9	809	0.799	27.7	938	0.926
20.4	691	0.682	24.0	813	0.803	27.8	941	0.929
			24.1	816	0.806			
20.5	694	0.685	24.2	820	0.809	27.8	941	0.929
20.6	698	0.688	24.3	823	0.813	27.9	945	0.933
20.7	701	0.692				28.0	948	0.936
20.8	704	0.696	24.4	826	0.816	28.1	952	0.939
20.9	708	0.699	24.5	830	0.820	28.2	955	0.942
			24.6	833	0.823			
21.0	711	0.703	24.7	836	0.826	28.3	958	0.946
21.1	715	0.706	24.8	840	0.829	28.4	962	0.949
21.2	718	0.709				28.5	965	0.953
21.3	721	0.712	24.9	843	0.832	28.6	969	0.956
21.4	725	0.716	25.0	847	0.835	28.7	972	0.959
			25.1	850	0.838			
21.5	728	0.719	25.2	853	0.842	28.8	975	0.963
21.6	731	0.722	25.3	857	0.846	28.9	979	0.966
21.7	735	0.725				29.0	982	0.970
21.8	738	0.729	25.4	860	0.849	29.1	985	0.973
21.9	742	0.732	25.5	864	0.853	29.2	989	0.976
			25.6	867	0.856			
22.0	745	0.735	25.7	870	0.859	29.3	992	0.979
22.1	748	0.739	25.8	874	0.862	29.4	996	0.983
22.2	752	0.742				29.5	999	0.986
22.3	755	0.746	25.9	877	0.866	29.6	1002	0.989
22.4	759	0.749	26.0	880	0.869	29.7	1006	0.992
			26.1	884	0.872			
22.5	762	0.752	26.2	887	0.875	29.8	1009	0.996
22.6	765	0.755	26.3	891	0.879	29.9	1013	0.999
22.7	769	0.759				30.0	1016	1.003
22.8	772	0.762	26.4	894	0.882	30.1	1019	1.007
22.9	775	0.766	26.5	897	0.885	30.2	1023	1.010
			26.6	901	0.889			
23.0	779	0.770	26.7	904	0.892	30.3	1026	1.013
23.1	782	0.773	26.8	908	0.896	30.4	1029	1.016
23.2	786	0.776				30.5	1033	1.020
23.3	789	0.779	26.9	911	0.899	30.6	1036	1.023
23.4	792	0.783	27.0	914	0.902	30.7	1040	1.026
			27.1	918	0.905			
23.5	796	0.786	27.2	921	0.909	30.8	1043	1.029
23.6	799	0.789	27.3	924	0.912	30.9	1046	1.033
23.7	803	0.792				31.0	1050	1.036

Note. Omit Pressure Correction Factor for artillery surveys of fourth-order (1:3000) or lesser accuracies.

Table 2. Sun, 1977 for Zero Hours Universal Time (GMT)

Greenwich date		Apparent declination				Equation of time			Sidereal time			
		Degrees		Daily change (sec)	Mils		Min	Sec	Daily change (sec)	Hr	Min	Sec
		°	' "		Mils	Daily change (mils)						
JAN	0 FR	-23	6 13		- 410.73		- 2	55.1		6	38	11.1
	1 SA	-23	1 39	+ 274	- 409.38	+ 1.35	- 3	23.7	- 28.5	6	42	7.7
	2 SU	-22	56 37	+ 302	- 407.89	+ 1.49	- 3	51.9	- 28.2	6	46	4.2
	3 MO	-22	51 8	+ 329	- 406.26	+ 1.63	- 4	19.7	- 27.8	6	50	0.8
	4 TU	-22	45 12	+ 356	- 404.50	+ 1.76	- 4	47.2	- 27.5	6	53	57.4
	5 WE	-22	38 49	+ 383	- 402.61	+ 1.89	- 5	14.3	- 27.1	6	57	53.9
	6 TH	-22	31 58	+ 411	- 400.58	+ 2.03	- 5	40.9	- 26.6	7	1	50.5
	7 FR	-22	24 41	+ 437	- 398.43	+ 2.15	- 6	7.1	- 26.2	7	5	47.0
	8 SA	-22	16 58	+ 463	- 396.14	+ 2.29	- 6	32.8	- 25.7	7	9	43.6
	9 SU	-22	8 48	+ 490	- 393.72	+ 2.42	- 6	58.0	- 25.2	7	13	40.2
	10 MO	-22	0 12	+ 516	- 391.17	+ 2.55	- 7	22.7	- 24.7	7	17	36.7
	11 TU	-21	51 11	+ 541	- 388.50	+ 2.67	- 7	46.8	- 24.1	7	21	33.3
	12 WE	-21	41 43	+ 568	- 385.70	+ 2.80	- 8	10.4	- 23.6	7	25	29.8
	13 TH	-21	31 51	+ 592	- 382.77	+ 2.93	- 8	33.4	- 23.0	7	29	26.4
	14 FR	-21	21 33	+ 618	- 379.72	+ 3.05	- 8	55.8	- 22.4	7	33	22.9
	15 SA	-21	10 51	+ 642	- 376.55	+ 3.17	- 9	17.5	- 21.8	7	37	19.5
	16 SU	-20	59 44	+ 667	- 373.25	+ 3.30	- 9	38.6	- 21.1	7	41	16.0
	17 MO	-20	48 13	+ 691	- 369.84	+ 3.41	- 9	59.1	- 20.4	7	45	12.6
	18 TU	-20	36 19	+ 714	- 366.31	+ 3.53	-10	18.8	- 19.8	7	49	9.2
	19 WE	-20	24 1	+ 738	- 362.67	+ 3.64	-10	37.9	- 19.0	7	53	5.7
	20 TH	-20	11 20	+ 761	- 358.91	+ 3.76	-10	56.2	- 18.3	7	57	2.3
	21 FR	-19	58 16	+ 784	- 355.04	+ 3.87	-11	13.8	- 17.6	8	0	58.8
	22 SA	-19	44 50	+ 806	- 351.06	+ 3.98	-11	30.6	- 16.8	8	4	55.4
	23 SU	-19	31 2	+ 828	- 346.97	+ 4.09	-11	46.6	- 16.0	8	8	51.9
	24 MO	-19	16 52	+ 850	- 342.78	+ 4.19	-12	1.9	- 15.2	8	12	48.5
	25 TU	-19	2 21	+ 871	- 338.47	+ 4.31	-12	16.3	- 14.4	8	16	45.0
	26 WE	-18	47 29	+ 892	- 334.07	+ 4.40	-12	29.9	- 13.6	8	20	41.6
	27 TH	-18	32 17	+ 912	- 329.57	+ 4.50	-12	42.8	- 12.8	8	24	38.2
	28 FR	-18	16 45	+ 932	- 324.96	+ 4.61	-12	54.7	- 12.0	8	28	34.7
	29 SA	-18	0 52	+ 953	- 320.26	+ 4.70	-13	5.9	- 11.2	8	32	31.3
	30 SU	-17	44 41	+ 971	- 315.46	+ 4.80	-13	16.2	- 10.3	8	36	27.8
	31 MO	-17	28 11	+ 990	- 310.57	+ 4.89	-13	25.7	- 9.5	8	40	24.4
				+1009		+ 4.98			- 8.7			

Table 2. Sun, 1977 for Zero Hours Universal Time (GMT) — Continued

Greenwich date	Apparent declination					Equation of time			Sidereal time		
	Degrees			Mils		Min	Sec	Daily change (sec)	Hr	Min	Sec
	°	'	"	Daily change (sec)	Daily change (mils)						
FEB 1 TU	-17	11	22		- 305.59	-13	34.4		8	44	20.9
2 WE	-16	54	15	+1027	+ 5.07	-13	42.2	- 7.8	8	48	17.5
3 TH	-16	36	50	+1045	+ 5.16	-13	49.2	- 7.0	8	52	14.1
4 FR	-16	19	8	+1062	+ 5.25	-13	55.4	- 6.2	8	56	10.6
5 SA	-16	1	9	+1079	+ 5.33	-14	0.7	- 5.4	9	0	7.2
6 SU	-15	42	53	+1096	+ 5.41	-14	5.3	- 4.6	9	4	3.7
7 MO	-15	24	22	+1111	+ 5.49	-14	9.1	- 3.8	9	8	0.3
8 TU	-15	5	34	+1128	+ 5.56	-14	12.0	- 3.0	9	11	56.8
9 WE	-14	46	31	+1143	+ 5.65	-14	14.2	- 2.2	9	15	53.4
10 TH	-14	27	13	+1158	+ 5.72	-14	15.6	- 1.4	9	19	49.9
11 FR	-14	7	41	+1172	+ 5.79	-14	16.3	- 0.7	9	23	46.5
12 SA	-13	47	54	+1187	+ 5.86	-14	16.3	+ 0.1	9	27	43.0
13 SU	-13	27	54	+1200	+ 5.92	-14	15.4	+ 0.8	9	31	39.6
14 MO	-13	7	40	+1214	+ 6.00	-14	13.9	+ 1.5	9	35	36.1
15 TU	-12	47	14	+1226	+ 6.05	-14	11.6	+ 2.3	9	39	32.7
16 WE	-12	26	35	+1239	+ 6.12	-14	8.6	+ 3.0	9	43	29.3
17 TH	-12	5	44	+1251	+ 6.18	-14	4.9	+ 3.7	9	47	25.8
18 FR	-11	44	41	+1263	+ 6.23	-14	0.5	+ 4.4	9	51	22.4
19 SA	-11	23	28	+1273	+ 6.29	-13	55.5	+ 5.1	9	55	18.9
20 SU	-11	2	4	+1284	+ 6.34	-13	49.7	+ 5.8	9	59	15.5
21 MO	-10	40	29	+1295	+ 6.40	-13	43.3	+ 6.4	10	3	12.0
22 TU	-10	18	45	+1304	+ 6.44	-13	36.2	+ 7.1	10	7	8.6
23 WE	- 9	56	51	+1314	+ 6.49	-13	28.4	+ 7.7	10	11	5.1
24 TH	- 9	34	48	+1323	+ 6.53	-13	20.1	+ 8.4	10	15	1.7
25 FR	- 9	12	37	+1331	+ 6.57	-13	11.1	+ 9.0	10	18	58.2
26 SA	- 8	50	17	+1340	+ 6.62	-13	1.5	+ 9.6	10	22	54.8
27 SU	- 8	27	50	+1347	+ 6.65	-12	51.3	+ 10.2	10	26	51.3
28 MO	- 8	5	15	+1355	+ 6.69	-12	40.6	+ 10.7	10	30	47.9
				+1362	+ 6.73			+ 11.3			

Table 2. Sun, 1977 for Zero Hours Universal Time (GMT) — Continued

Greenwich date	Apparent declination					Equation of time			Sidereal time		
	Degrees				Mils	Min	Sec	Daily change (sec)	Hr	Min	Sec
	°	'	''	Daily change (sec)	Mils						
MAR 1 TU	-	7	42 33		- 137.05	-12	29.3		10	34	44.4
2 WE	-	7	19 45	+1368	- 130.29	-12	17.5	+ 11.8	10	38	41.0
3 TH	-	6	56 50	+1375	- 123.51	-12	5.2	+ 12.3	10	42	37.5
4 FR	-	6	33 50	+1380	- 116.69	-11	52.4	+ 12.8	10	46	34.1
5 SA	-	6	10 44	+1386	- 109.85	-11	39.1	+ 13.3	10	50	30.6
6 SU	-	5	47 33	+1391	- 102.98	-11	25.4	+ 13.7	10	54	27.2
7 MO	-	5	24 17	+1396	- 96.08	-11	11.3	+ 14.1	10	58	23.7
8 TU	-	5	0 57	+1400	- 89.17	-10	56.8	+ 14.5	11	2	20.3
9 WE	-	4	37 33	+1404	- 82.24	-10	41.9	+ 14.9	11	6	16.8
10 TH	-	4	14 5	+1408	- 75.28	-10	26.6	+ 15.3	11	10	13.4
11 FR	-	3	50 34	+1411	- 68.32	-10	11.0	+ 15.6	11	14	9.9
12 SA	-	3	27 0	+1414	- 61.33	- 9	55.2	+ 15.9	11	18	6.5
13 SU	-	3	3 24	+1416	- 54.34	- 9	39.0	+ 16.1	11	22	3.1
14 MO	-	2	39 45	+1419	- 47.33	- 9	22.6	+ 16.4	11	25	59.6
15 TU	-	2	16 5	+1420	- 40.32	- 9	5.5	+ 16.7	11	29	56.2
16 WE	-	1	52 23	+1422	- 33.30	- 8	49.1	+ 16.9	11	33	52.7
17 TH	-	1	28 40	+1423	- 26.27	- 8	32.0	+ 17.1	11	37	49.3
18 FR	-	1	4 57	+1423	- 19.24	- 8	14.7	+ 17.3	11	41	45.8
19 SA	-	0	41 13	+1424	- 12.21	- 7	57.3	+ 17.4	11	45	42.4
20 SU	-	0	17 30	+1423	- 5.18	- 7	39.6	+ 17.6	11	49	38.9
21 MO	+	0	6 13	+1423	+ 1.84	- 7	21.9	+ 17.7	11	53	35.5
22 TU	+	0	29 55	+1422	+ 8.86	- 7	4.0	+ 17.9	11	57	32.0
23 WE	+	0	53 36	+1421	+ 15.88	- 6	46.1	+ 18.0	12	1	28.6
24 TH	+	1	17 14	+1418	+ 22.89	- 6	28.0	+ 18.0	12	5	25.1
25 FR	+	1	40 51	+1417	+ 29.88	- 6	9.9	+ 18.1	12	9	21.7
26 SA	+	2	4 26	+1415	+ 36.87	- 5	51.7	+ 18.2	12	13	18.2
27 SU	+	2	27 58	+1412	+ 43.84	- 5	33.5	+ 18.2	12	17	14.8
28 MO	+	2	51 26	+1408	+ 50.80	- 5	15.3	+ 18.2	12	21	11.3
29 TU	+	3	14 51	+1405	+ 57.74	- 4	57.0	+ 18.2	12	25	7.9
30 WE	+	3	38 13	+1402	+ 64.66	- 4	38.9	+ 18.2	12	29	4.4
31 TH	+	4	1 30	+1397	+ 71.56	- 4	20.7	+ 18.1	12	33	1.0
				+1393	+ 6.87			+ 18.1			

Table 2. Sun, 1977 for Zero Hours Universal Time (GMT) — Continued

Greenwich date	Apparent declination					Equation of time			Sidereal time		
	Degrees			Mils		Min	Sec	Daily change (sec)	Hr	Min	Sec
	°	'	"	Daily change (sec)	Daily change (mils)						
APR 1 FR	+ 4	24	43	+1387	+ 78.43	- 4	2.6	+ 18.0	12	36	57.6
2 SA	+ 4	47	50	+1383	+ 85.29	- 3	44.7	+ 17.9	12	40	54.1
3 SU	+ 5	10	53	+1377	+ 92.11	- 3	26.8	+ 17.7	12	44	50.6
4 MO	+ 5	33	50	+1371	+ 98.91	- 3	9.0	+ 17.6	12	48	47.2
5 TU	+ 5	56	41	+1365	+ 105.68	- 2	51.4	+ 17.4	12	52	43.7
6 WE	+ 6	19	26	+1359	+ 112.43	- 2	34.0	+ 17.2	12	56	40.3
7 TH	+ 6	42	5	+1352	+ 119.14	- 2	16.8	+ 17.0	13	0	36.8
8 FR	+ 7	4	37	+1344	+ 125.81	- 1	59.9	+ 16.7	13	4	33.4
9 SA	+ 7	27	1	+1338	+ 132.45	- 1	43.1	+ 16.5	13	8	30.0
10 SU	+ 7	49	19	+1329	+ 139.06	- 1	26.7	+ 16.2	13	12	26.5
11 MO	+ 8	11	28	+1322	+ 145.62	- 1	10.5	+ 15.9	13	16	23.1
12 TU	+ 8	33	30	+1312	+ 152.15	- 0	54.6	+ 15.5	13	20	19.6
13 WE	+ 8	55	22	+1304	+ 158.63	- 0	39.1	+ 15.2	13	24	16.2
14 TH	+ 9	17	6	+1295	+ 165.07	- 0	23.9	+ 14.9	13	28	12.7
15 FR	+ 9	38	41	+1285	+ 171.46	- 0	9.0	+ 14.5	13	32	9.3
16 SA	+10	0	6	+1275	+ 177.81	+ 0	5.5	+ 14.1	13	36	5.8
17 SU	+10	21	21	+1266	+ 184.11	+ 0	19.6	+ 13.8	13	40	2.4
18 MO	+10	42	27	+1254	+ 190.35	+ 0	33.4	+ 13.4	13	43	58.9
19 TU	+11	3	21	+1243	+ 196.55	+ 0	46.8	+ 13.0	13	47	55.5
20 WE	+11	24	4	+1233	+ 202.69	+ 0	59.7	+ 12.5	13	51	52.0
21 TH	+11	44	37	+1220	+ 208.77	+ 1	12.3	+ 12.1	13	55	48.6
22 FR	+12	4	57	+1209	+ 214.80	+ 1	24.4	+ 11.7	13	59	45.1
23 SA	+12	25	6	+1196	+ 220.77	+ 1	36.1	+ 11.3	14	3	41.7
24 SU	+12	45	2	+1184	+ 226.68	+ 1	47.3	+ 10.8	14	7	38.3
25 MO	+13	4	46	+1171	+ 232.52	+ 1	58.1	+ 10.3	14	11	34.8
26 TU	+13	24	17	+1158	+ 238.31	+ 2	8.4	+ 9.8	14	15	31.4
27 WE	+13	43	35	+1144	+ 244.02	+ 2	18.3	+ 9.4	14	19	27.9
28 TH	+14	2	39	+1130	+ 249.67	+ 2	27.6	+ 8.9	14	23	24.5
29 FR	+14	21	29	+1115	+ 255.25	+ 2	36.5	+ 8.4	14	27	21.0
30 SA	+14	40	4	+1101	+ 260.76	+ 2	44.9	+ 7.9	14	31	17.6

Table 2. Sun, 1977 for Zero Hours Universal Time (GMT) — Continued

Greenwich date		Apparent declination				Equation of time			Sidereal time		
		Degrees		Mils		Min	Sec	Daily change (sec)	Hr	Min	Sec
		°	' "	Daily change (sec)	Daily change (mils)						
MAY	1 SU	+14	58 25	+1087	+ 266.20 + 5.36	+ 2	52.8	+ 7.3	14	35	14.1
	2 MO	+15	16 32	+1071	+ 271.56 + 5.29	+ 3	0.1	+ 6.8	14	39	10.7
	3 TU	+15	34 23	+1055	+ 276.85 + 5.22	+ 3	6.9	+ 6.3	14	43	7.2
	4 WE	+15	51 58	+1040	+ 282.07 + 5.13	+ 3	13.2	+ 5.7	14	47	3.8
	5 TH	+16	9 18	+1024	+ 287.20 + 5.06	+ 3	18.9	+ 5.1	14	51	0.3
	6 FR	+16	26 22	+1007	+ 292.26 + 4.97	+ 3	24.1	+ 4.6	14	54	56.9
	7 SA	+16	43 9	+ 991	+ 297.23 + 4.90	+ 3	28.6	+ 4.0	14	58	53.5
	8 SU	+16	59 40	+ 974	+ 302.13 + 4.80	+ 3	32.6	+ 3.4	15	2	50.0
	9 MO	+17	15 54	+ 957	+ 306.93 + 4.73	+ 3	36.0	+ 2.8	15	6	46.6
	10 TU	+17	31 51	+ 939	+ 311.66 + 4.64	+ 3	38.8	+ 2.2	15	10	43.1
	11 WE	+17	47 30	+ 921	+ 316.30 + 4.55	+ 3	41.0	+ 1.6	15	14	39.7
	12 TH	+18	2 51	+ 903	+ 320.85 + 4.46	+ 3	42.6	+ 1.0	15	18	36.2
	13 FR	+18	17 54	+ 885	+ 325.31 + 4.36	+ 3	43.7	+ 0.4	15	22	32.8
	14 SA	+18	32 39	+ 866	+ 329.67 + 4.28	+ 3	44.1	- 0.1	15	26	29.3
	15 SU	+18	47 5	+ 847	+ 333.95 + 4.18	+ 3	44.0	- 0.7	15	30	25.9
	16 MO	+19	1 12	+ 828	+ 338.13 + 4.09	+ 3	43.3	- 1.3	15	34	22.4
	17 TU	+19	15 0	+ 808	+ 342.22 + 3.99	+ 3	42.0	- 1.9	15	38	19.0
	18 WE	+19	28 28	+ 788	+ 346.21 + 3.89	+ 3	40.1	- 2.4	15	42	15.6
	19 TH	+19	41 36	+ 768	+ 350.10 + 3.80	+ 3	37.7	- 3.0	15	46	12.1
	20 FR	+19	54 24	+ 743	+ 353.90 + 3.69	+ 3	34.7	- 3.5	15	50	8.7
	21 SA	+20	6 52	+ 727	+ 357.59 + 3.59	+ 3	31.2	- 4.0	15	54	5.2
	22 SU	+20	18 59	+ 706	+ 361.18 + 3.49	+ 3	27.2	- 4.5	15	58	1.8
	23 MO	+20	30 45	+ 685	+ 364.67 + 3.38	+ 3	22.6	- 5.0	16	1	58.3
	24 TU	+20	42 10	+ 664	+ 368.05 + 3.28	+ 3	17.6	- 5.5	16	5	54.9
	25 WE	+20	53 14	+ 642	+ 371.33 + 3.17	+ 3	12.0	- 6.0	16	9	51.5
	26 TH	+21	3 56	+ 621	+ 374.50 + 3.06	+ 3	6.0	- 6.5	16	13	48.0
	27 FR	+21	14 17	+ 598	+ 377.56 + 2.96	+ 2	59.5	- 6.9	16	17	44.6
	28 SA	+21	24 15	+ 576	+ 380.52 + 2.84	+ 2	52.6	- 7.4	16	21	41.1
	29 SU	+21	33 51	+ 554	+ 383.36 + 2.74	+ 2	45.2	- 7.8	16	25	37.7
	30 MO	+21	43 5	+ 531	+ 386.10 + 2.62	+ 2	37.4	- 8.3	16	29	34.2
	31 TU	+21	51 56	+ 508	+ 388.72 + 2.51	+ 2	29.1	- 8.6	16	33	30.8

Table 2. Sun, 1977 for Zero Hours Universal Time (GMT) — Continued

Greenwich date	Apparent declination					Equation of time			Sidereal time		
	Degrees				Mils	Min	Sec	Daily change (sec)	Hr	Min	Sec
	°	'	"	Daily change (sec)	Daily change (mils)						
JUN 1 WE	+22	0	24		+ 391.23	+ 2	20.5		16	37	27.3
2 TH	+22	8	29	+ 485	+ 393.62	+ 2	11.4	- 9.0	16	41	23.9
3 FR	+22	16	11	+ 462	+ 395.91	+ 2	2.0	- 9.4	16	45	20.5
4 SA	+22	23	30	+ 439	+ 398.07	+ 1	52.2	- 9.8	16	49	17.0
5 SU	+22	30	25	+ 415	+ 400.12	+ 1	42.0	- 10.2	16	53	13.6
6 MO	+22	36	56	+ 391	+ 402.06	+ 1	31.4	- 10.5	16	57	10.1
7 TU	+22	43	4	+ 368	+ 403.87	+ 1	20.6	- 10.9	17	1	6.7
8 WE	+22	48	48	+ 344	+ 405.57	+ 1	9.4	- 11.2	17	5	3.3
9 TH	+22	54	8	+ 320	+ 407.15	+ 0	57.9	- 11.5	17	8	59.8
10 FR	+22	59	4	+ 296	+ 408.61	+ 0	46.2	- 11.8	17	12	56.4
11 SA	+23	3	35	+ 271	+ 409.95	+ 0	34.2	- 12.0	17	16	52.9
12 SU	+23	7	42	+ 247	+ 411.17	+ 0	21.9	- 12.2	17	20	49.5
13 MO	+23	11	25	+ 223	+ 412.27	+ 0	9.5	- 12.4	17	24	46.0
14 TU	+23	14	43	+ 198	+ 413.25	- 0	3.1	- 12.6	17	28	42.6
15 WE	+23	17	36	+ 173	+ 414.10	- 0	15.9	- 12.8	17	32	39.1
16 TH	+23	20	5	+ 149	+ 414.84	- 0	28.8	- 12.9	17	36	35.7
17 FR	+23	22	9	+ 124	+ 415.45	- 0	41.8	- 13.0	17	40	32.3
18 SA	+23	23	49	+ 100	+ 415.94	- 0	54.9	- 13.1	17	44	28.8
19 SU	+23	25	4	+ 75	+ 416.31	- 1	8.0	- 13.1	17	48	25.4
20 MO	+23	25	53	+ 49	+ 416.56	- 1	21.1	- 13.1	17	52	21.9
21 TU	+23	26	19	+ 26	+ 416.68	- 1	34.3	- 13.1	17	56	18.5
22 WE	+23	26	19	+ 0	+ 416.69	- 1	47.4	- 13.1	18	0	15.0
23 TH	+23	25	54	- 25	+ 416.56	- 2	0.4	- 13.0	18	4	11.6
24 FR	+23	25	5	- 49	+ 416.32	- 2	13.4	- 12.9	18	8	8.1
25 SA	+23	23	51	- 74	+ 415.96	- 2	26.2	- 12.9	18	12	4.7
26 SU	+23	22	13	- 98	+ 415.47	- 2	39.0	- 12.7	18	16	1.3
27 MO	+23	20	9	- 124	+ 414.86	- 2	51.5	- 12.5	18	19	57.8
28 TU	+23	17	41	- 148	+ 414.13	- 3	3.9	- 12.4	18	23	54.4
29 WE	+23	14	49	- 172	+ 413.28	- 3	16.1	- 12.2	18	27	50.9
30 TH	+23	11	32	- 197	+ 412.31	- 3	28.0	- 12.0	18	31	47.5
				- 221	- 1.10			- 11.7			

Table 2. Sun, 1977 for Zero Hours Universal Time (GMT) — Continued

Greenwich date	Apparent declination					Equation of time			Sidereal time		
	Degrees				Mils	Min	Sec	Daily change (sec)	Hr	Min	Sec
	°	'	"	Daily change (sec)	Mils						
JUL 1 FR	+23	7	51		+ 411.21	- 3	39.8		18	35	44.1
2 SA	+23	3	45	- 246	+ 410.00	- 3	51.3	- 11.5	18	39	40.6
3 SU	+22	59	15	- 270	+ 408.67	- 4	2.5	- 11.2	18	43	37.2
4 MO	+22	54	22	- 293	+ 407.22	- 4	13.4	- 10.9	18	47	33.7
5 TU	+22	49	4	- 318	+ 405.65	- 4	24.0	- 10.6	18	51	30.3
6 WE	+22	43	22	- 342	+ 403.96	- 4	34.4	- 10.3	18	55	26.8
7 TH	+22	37	17	- 365	+ 402.16	- 4	44.4	- 10.0	18	59	23.4
8 FR	+22	30	48	- 389	+ 400.24	- 4	54.0	- 9.6	19	3	19.9
9 SA	+22	23	56	- 412	+ 398.20	- 5	3.3	- 9.3	19	7	16.5
10 SU	+22	16	40	- 436	+ 396.05	- 5	12.2	- 8.9	19	11	13.0
11 MO	+22	9	1	- 459	+ 393.78	- 5	20.7	- 8.5	19	15	9.6
12 TU	+22	1	0	- 481	+ 391.41	- 5	28.7	- 8.0	19	19	6.2
13 WE	+21	52	36	- 504	+ 388.92	- 5	36.3	- 7.6	19	23	2.7
14 TH	+21	43	49	- 527	+ 386.32	- 5	43.5	- 7.2	19	26	59.3
15 FR	+21	34	40	- 549	+ 383.60	- 5	50.2	- 6.7	19	30	55.8
16 SA	+21	25	9	- 571	+ 380.79	- 5	56.3	- 6.2	19	34	52.4
17 SU	+21	15	16	- 593	+ 377.86	- 6	2.0	- 5.7	19	38	49.0
18 MO	+21	5	2	- 614	+ 374.82	- 6	7.2	- 5.1	19	42	45.5
19 TU	+20	54	26	- 636	+ 371.68	- 6	11.8	- 4.6	19	46	42.1
20 WE	+20	43	29	- 657	+ 368.44	- 6	15.8	- 4.1	19	50	38.6
21 TH	+20	32	11	- 678	+ 365.09	- 6	19.3	- 3.5	19	54	35.2
22 FR	+20	20	33	- 698	+ 361.64	- 6	22.2	- 2.9	19	58	31.7
23 SA	+20	8	34	- 719	+ 358.09	- 6	24.6	- 2.3	20	2	28.3
24 SU	+19	56	15	- 739	+ 354.44	- 6	26.3	- 1.7	20	6	24.8
25 MO	+19	43	36	- 759	+ 350.69	- 6	27.4	- 1.1	20	10	21.4
26 TU	+19	30	37	- 779	+ 346.85	- 6	27.9	- 0.5	20	14	17.9
27 WE	+19	17	19	- 798	+ 342.91	- 6	27.8	+ 0.1	20	18	14.5
28 TH	+19	3	42	- 817	+ 338.87	- 6	27.1	+ 0.7	20	22	11.1
29 FR	+18	49	46	- 836	+ 334.75	- 6	25.7	+ 1.3	20	26	7.6
30 SA	+18	35	32	- 854	+ 330.53	- 6	23.8	+ 1.9	20	30	4.2
31 SU	+18	20	59	- 873	+ 326.22	- 6	21.2	+ 2.6	20	34	0.7
				- 891	/			+ 3.2			

Table 2. Sun, 1977 for Zero Hours Universal Time (GMT) — Continued

Greenwich date	Apparent declination					Equation of time			Sidereal time		
	Degrees			Mils		Min	Sec	Daily change (sec)	Hr	Min	Sec
	°	'	"	Daily change (sec)	Daily change (mils)						
AUG 1 MO	+18	6	8	- 908	+ 321.82 - 4.45	- 6	18.0	+ 3.8	20	37	57.3
2 TU	+17	51	0	- 926	+ 317.33 - 4.57	- 6	14.3	+ 4.4	20	41	53.8
3 WE	+17	35	34	- 943	+ 312.76 - 4.66	- 6	9.9	+ 4.9	20	45	50.4
4 TH	+17	19	51	- 960	+ 308.10 - 4.74	- 6	5.0	+ 5.5	20	49	46.9
5 FR	+17	3	51	- 977	+ 303.36 - 4.82	- 5	59.4	+ 6.1	20	53	43.5
6 SA	+16	47	34	- 993	+ 298.54 - 4.91	- 5	53.3	+ 6.7	20	57	40.0
7 SU	+16	31	1	-1010	+ 293.63 - 4.98	- 5	46.6	+ 7.3	21	1	36.6
8 MO	+16	14	11	-1025	+ 288.65 - 5.06	- 5	39.3	+ 7.8	21	5	33.2
9 TU	+15	57	6	-1040	+ 283.59 - 5.14	- 5	31.5	+ 8.4	21	9	29.7
10 WE	+15	39	46	-1055	+ 278.45 - 5.21	- 5	23.1	+ 9.0	21	13	26.3
11 TH	+15	22	11	-1071	+ 273.24 - 5.29	- 5	14.1	+ 9.5	21	17	22.8
12 FR	+15	4	20	-1084	+ 267.95 - 5.35	- 5	4.6	+ 10.1	21	21	19.4
13 SA	+14	46	16	-1099	+ 262.60 - 5.43	- 4	54.5	+ 10.6	21	25	15.9
14 SU	+14	27	57	-1113	+ 257.17 - 5.50	- 4	43.9	+ 11.2	21	29	12.5
15 MO	+14	9	24	-1126	+ 251.67 - 5.56	- 4	32.7	+ 11.7	21	33	9.0
16 TU	+13	50	38	-1139	+ 246.11 - 5.62	- 4	21.0	+ 12.2	21	37	5.6
17 WE	+13	31	39	-1152	+ 240.49 - 5.69	- 4	8.8	+ 12.8	21	41	2.1
18 TH	+13	12	27	-1165	+ 234.80 - 5.75	- 3	56.0	+ 13.3	21	44	58.7
19 FR	+12	53	2	-1177	+ 229.05 - 5.81	- 3	42.8	+ 13.8	21	48	55.2
20 SA	+12	33	25	-1188	+ 223.24 - 5.87	- 3	29.0	+ 14.3	21	52	51.8
21 SU	+12	13	37	-1200	+ 217.37 - 5.93	- 3	14.7	+ 14.8	21	56	48.3
22 MO	+11	53	37	-1212	+ 211.44 - 5.98	- 2	59.9	+ 15.2	22	0	44.9
23 TU	+11	33	25	-1222	+ 205.46 - 6.04	- 2	44.7	+ 15.7	22	4	41.5
24 WE	+11	13	3	-1233	+ 199.42 - 6.09	- 2	29.0	+ 16.1	22	8	38.0
25 TH	+10	52	30	-1243	+ 193.33 - 6.14	- 2	12.9	+ 16.6	22	12	34.6
26 FR	+10	31	47	-1253	+ 187.19 - 6.18	- 1	56.3	+ 17.0	22	16	31.1
27 SA	+10	10	54	-1263	+ 181.01 - 6.24	- 1	39.3	+ 17.4	22	20	27.7
28 SU	+ 9	49	51	-1272	+ 174.77 - 6.28	- 1	21.9	+ 17.8	22	24	24.2
29 MO	+ 9	28	39	-1281	+ 168.49 - 6.33	- 1	4.2	+ 18.1	22	28	20.8
30 TU	+ 9	7	18	-1290	+ 162.16 - 6.37	- 0	46.1	+ 18.4	22	32	17.3
31 WE	+ 8	45	48	-1299	+ 155.79 - 6.41	- 0	27.6	+ 18.8	22	36	13.9

Table 2. Sun, 1977 for Zero Hours Universal Time (GMT) — Continued

Greenwich date	Apparent declination				Equation of time			Sidereal time		
	Degrees		Mils		Min	Sec	Daily change (sec)	Hr	Min	Sec
	°	' "	Mils	Daily change (mils)						
SEP 1 TH	+ 8	24 9	+ 149.38	- 6.45	- 0	8.9		22	40	10.4
2 FR	+ 8	2 23	+ 142.93	- 6.45	+ 0	10.1	+ 19.0	22	44	7.0
3 SA	+ 7	40 28	+ 136.44	- 6.49	+ 0	29.4	+ 19.3	22	48	3.5
4 SU	+ 7	18 27	+ 129.91	- 6.53	+ 0	49.0	+ 19.6	22	52	0.1
5 MO	+ 6	56 17	+ 123.34	- 6.57	+ 1	8.8	+ 19.8	22	55	56.6
6 TU	+ 6	34 1	+ 116.75	- 6.59	+ 1	28.8	+ 20.0	22	59	53.2
7 WE	+ 6	11 39	+ 110.12	- 6.63	+ 1	49.1	+ 20.2	23	3	49.8
8 TH	+ 5	49 10	+ 103.46	- 6.66	+ 2	9.5	+ 20.4	23	7	46.3
9 FR	+ 5	26 35	+ 96.77	- 6.69	+ 2	30.0	+ 20.6	23	11	42.9
10 SA	+ 5	3 55	+ 90.05	- 6.72	+ 2	50.7	+ 20.7	23	15	39.4
11 SU	+ 4	41 10	+ 83.31	- 6.74	+ 3	11.6	+ 20.8	23	19	36.0
12 MO	+ 4	18 20	+ 76.54	- 6.77	+ 3	32.5	+ 20.9	23	23	32.5
13 TU	+ 3	55 25	+ 69.75	- 6.79	+ 3	53.6	+ 21.1	23	27	29.1
14 WE	+ 3	32 26	+ 62.94	- 6.81	+ 4	14.7	+ 21.1	23	31	25.6
15 TH	+ 3	9 23	+ 56.11	- 6.83	+ 4	35.9	+ 21.2	23	35	22.2
16 FR	+ 2	46 17	+ 49.27	- 6.84	+ 4	57.2	+ 21.3	23	39	18.7
17 SA	+ 2	23 7	+ 42.41	- 6.86	+ 5	18.4	+ 21.3	23	43	15.3
18 SU	+ 1	59 55	+ 35.53	- 6.88	+ 5	39.8	+ 21.3	23	47	11.8
19 MO	+ 1	36 40	+ 28.64	- 6.89	+ 6	1.1	+ 21.3	23	51	8.4
20 TU	+ 1	13 24	+ 21.75	- 6.89	+ 6	22.4	+ 21.3	23	55	4.9
21 WE	+ 0	50 5	+ 14.84	- 6.91	+ 6	43.6	+ 21.3	23	59	1.5
22 TH	+ 0	26 45	+ 7.93	- 6.91	+ 7	4.8	+ 21.2	0	2	58.0
23 FR	+ 0	3 24	+ 1.01	- 6.92	+ 7	25.9	+ 21.1	0	6	54.6
24 SA	- 0	19 57	- 5.91	- 6.92	+ 7	46.9	+ 21.0	0	10	51.1
25 SU	- 0	43 20	- 12.84	- 6.93	+ 8	7.8	+ 20.9	0	14	47.7
26 MO	- 1	6 42	- 19.76	- 6.92	+ 8	28.6	+ 20.7	0	18	44.2
27 TU	- 1	30 4	- 26.69	- 6.93	+ 8	49.2	+ 20.6	0	22	40.8
28 WE	- 1	53 25	- 33.61	- 6.92	+ 9	9.5	+ 20.4	0	26	37.3
29 TH	- 2	16 46	- 40.52	- 6.91	+ 9	29.7	+ 20.1	0	30	33.9
30 FR	- 2	40 5	- 47.43	- 6.91	+ 9	49.6	+ 19.9	0	34	30.4
		-1398		- 6.91			+ 19.6			

Table 2. Sun, 1977 for Zero Hours Universal Time (GMT) — Continued

Greenwich date			Apparent declination					Equation of time			Sidereal time							
			Degrees			Mils												
			°	'	''	Daily change (sec)	Mils							Daily change (mils)				
									Min	Sec	Daily change (sec)	Hr	Min	Sec				
OCT	1	SA	-	3	3	23	-1396	-	54.34	-	6.89	+10	9.2	+	19.3	0	38	27.0
	2	SU	-	3	26	39	-1394	-	61.23	-	6.88	+10	28.5	+	19.0	0	42	23.5
	3	MO	-	3	49	53	-1391	-	68.11	-	6.88	+10	47.6	+	18.7	0	46	20.1
	4	TU	-	4	13	4	-1389	-	74.99	-	6.85	+11	6.3	+	18.3	0	50	16.7
	5	WE	-	4	36	13	-1385	-	81.84	-	6.84	+11	24.6	+	17.9	0	54	13.2
	6	TH	-	4	59	18	-1381	-	88.68	-	6.82	+11	42.5	+	17.6	0	58	9.8
	7	FR	-	5	22	19	-1377	-	95.50	-	6.80	+12	0.1	+	17.1	1	2	6.3
	8	SA	-	5	45	16	-1373	-	102.30	-	6.78	+12	17.3	+	16.7	1	6	2.9
	9	SU	-	6	8	9	-1369	-	109.08	-	6.76	+12	33.9	+	16.3	1	9	59.4
10	MO		-	6	30	58	-1363	-	115.84	-	6.73	+12	50.2	+	15.8	1	13	56.0
11	TU		-	6	53	41	-1357	-	122.57	-	6.70	+13	6.0	+	15.3	1	17	52.5
12	WE		-	7	16	18	-1352	-	129.27	-	6.68	+13	21.3	+	14.8	1	21	49.1
13	TH		-	7	38	50	-1345	-	135.95	-	6.64	+13	36.0	+	14.3	1	25	45.6
14	FR		-	8	1	15	-1338	-	142.59	-	6.61	+13	50.3	+	13.8	1	29	42.2
15	SA		-	8	23	33	-1332	-	149.20	-	6.58	+14	4.0	+	13.2	1	33	38.7
16	SU		-	8	45	45	-1324	-	155.78	-	6.53	+14	17.2	+	12.6	1	37	35.3
17	MO		-	9	7	49	-1316	-	162.31	-	6.50	+14	29.9	+	12.1	1	41	31.8
18	TU		-	9	29	45	-1307	-	168.81	-	6.46	+14	41.9	+	11.5	1	45	28.4
19	WE		-	9	51	32	-1299	-	175.27	-	6.42	+14	53.4	+	10.9	1	49	24.9
20	TH		-	10	13	11	-1290	-	181.69	-	6.37	+15	4.3	+	10.3	1	53	21.5
21	FR		-	10	34	41	-1281	-	188.06	-	6.32	+15	14.6	+	9.6	1	57	18.1
22	SA		-	10	56	2	-1270	-	194.38	-	6.27	+15	24.2	+	9.0	2	1	14.6
23	SU		-	11	17	12	-1261	-	200.65	-	6.23	+15	33.2	+	8.3	2	5	11.2
24	MO		-	11	38	13	-1249	-	206.88	-	6.17	+15	41.5	+	7.6	2	9	7.7
25	TU		-	11	59	2	-1239	-	213.05	-	6.12	+15	49.1	+	6.9	2	13	4.3
26	WE		-	12	19	41	-1227	-	219.17	-	6.06	+15	56.0	+	6.2	2	17	0.8
27	TH		-	12	40	8	-1216	-	225.23	-	6.00	+16	2.2	+	5.4	2	20	57.4
28	FR		-	13	0	24	-1203	-	231.23	-	5.94	+16	7.6	+	4.7	2	24	53.9
29	SA		-	13	20	27	-1191	-	237.17	-	5.88	+16	12.3	+	3.9	2	28	50.5
30	SU		-	13	40	18	-1178	-	243.05	-	5.82	+16	16.3	+	3.1	2	32	47.0
31	MO		-	13	59	56	-1164	-	248.87	-	5.75	+16	19.4	+	2.3	2	36	43.6

Table 2. Sun, 1977 for Zero Hours Universal Time (GMT) — Continued

Greenwich date	Apparent declination					Equation of time			Sidereal time			
	Degrees			Mils		Min	Sec	Daily change (sec)	Hr	Min	Sec	
	°	'	''	Daily change (sec)	Mils							Daily change (mils)
NOV 1 TU	-14	19	20	-1151	- 254.62	- 5.68	+16	21.8	+ 1.5	2	40	40.1
2 WE	-14	38	31	-1137	- 260.30	- 5.62	+16	23.3	+ 0.7	2	44	36.7
3 TH	-14	57	28	-1122	- 265.92	- 5.54	+16	24.0	- 0.1	2	48	33.2
4 FR	-15	16	10	-1107	- 271.46	- 5.46	+16	23.9	- 0.9	2	52	29.8
5 SA	-15	34	37	-1092	- 276.92	- 5.40	+16	22.5	- 1.8	2	56	26.4
6 SU	-15	52	49	-1076	- 282.32	- 5.31	+16	21.1	- 2.6	3	0	22.9
7 MO	-16	10	45	-1060	- 287.63	- 5.23	+16	18.5	- 3.5	3	4	19.5
8 TU	-16	28	25	-1043	- 292.86	- 5.15	+16	15.0	- 4.4	3	8	16.0
9 WE	-16	45	48	-1026	- 298.01	- 5.07	+16	10.6	- 5.2	3	12	12.6
10 TH	-17	2	54	-1009	- 303.08	- 4.98	+16	5.4	- 6.1	3	16	9.1
11 FR	-17	19	43	- 991	- 308.06	- 4.90	+15	59.3	- 6.9	3	20	5.7
12 SA	-17	36	14	- 973	- 312.96	- 4.80	+15	52.4	- 7.8	3	24	2.2
13 SU	-17	52	27	- 954	- 317.76	- 4.71	+15	44.6	- 8.6	3	27	58.8
14 MO	-18	8	21	- 935	- 322.47	- 4.62	+15	36.0	- 9.4	3	31	55.3
15 TU	-18	23	56	- 916	- 327.09	- 4.52	+15	26.6	- 10.3	3	35	51.9
16 WE	-18	39	12	- 895	- 331.61	- 4.43	+15	16.3	- 11.1	3	39	48.5
17 TH	-18	54	7	- 876	- 336.04	- 4.32	+15	5.2	- 11.9	3	43	45.0
18 FR	-19	8	43	- 855	- 340.36	- 4.22	+14	53.3	- 12.7	3	47	41.6
19 SA	-19	22	58	- 834	- 344.58	- 4.12	+14	40.6	- 13.5	3	51	38.1
20 SU	-19	36	52	- 812	- 348.70	- 4.01	+14	27.1	- 14.3	3	55	34.7
21 MO	-19	50	24	- 791	- 352.71	- 3.91	+14	12.8	- 15.1	3	59	31.2
22 TU	-20	3	35	- 769	- 356.62	- 3.79	+13	57.7	- 15.9	4	3	27.8
23 WE	-20	16	24	- 746	- 360.41	- 3.69	+13	41.8	- 16.7	4	7	24.3
24 TH	-20	28	50	- 724	- 364.10	- 3.57	+13	25.1	- 17.4	4	11	20.9
25 FR	-20	40	54	- 700	- 367.67	- 3.46	+13	7.7	- 18.2	4	15	17.4
26 SA	-20	52	34	- 678	- 371.13	- 3.35	+12	45.5	- 18.9	4	19	14.0
27 SU	-21	3	52	- 653	- 374.48	- 3.22	+12	30.6	- 19.7	4	23	10.6
28 MO	-21	14	45	- 630	- 377.70	- 3.11	+12	10.9	- 20.4	4	27	7.1
29 TU	-21	25	15	- 605	- 380.81	- 2.99	+11	50.5	- 21.1	4	31	3.7
30 WE	-21	35	20	- 580	- 383.80	- 2.87	+11	29.4	- 21.8	4	35	0.2

Table 2. Sun, 1977 for Zero Hours Universal Time (GMT) — Continued

Greenwich date		Apparent declination				Equation of time			Sidereal time		
		Degrees		Mils		Min	Sec	Daily change (sec)	Hr	Min	Sec
		°	' "	Mils	Daily change (mils)						
DEC	1 TH	-21 45 0	- 556	- 386.67	- 2.74	+11	7.7	- 22.4	4	38	56.8
	2 FR	-21 54 16	- 530	- 389.41	- 2.62	+10	45.2	- 23.1	4	42	53.4
	3 SA	-22 3 6	- 505	- 392.03	- 2.49	+10	22.1	- 23.7	4	46	49.9
	4 SU	-22 11 31	- 479	- 394.52	- 2.37	+ 9	58.4	- 24.3	4	50	46.5
	5 MO	-22 19 30	- 453	- 396.89	- 2.24	+ 9	34.1	- 24.9	4	54	43.0
	6 TU	-22 27 3	- 427	- 399.13	- 2.10	+ 9	9.2	- 25.4	4	58	39.6
	7 WE	-22 34 10	- 400	- 401.23	- 1.98	+ 8	43.8	- 26.0	5	2	36.1
	8 TH	-22 40 50	- 374	- 403.21	- 1.85	+ 8	17.8	- 26.5	5	6	32.7
	9 FR	-22 47 4	- 347	- 405.06	- 1.71	+ 7	51.3	- 26.9	5	10	29.2
	10 SA	-22 52 51	- 320	- 406.77	- 1.58	+ 7	24.3	- 27.4	5	14	25.8
	11 SU	-22 58 11	- 292	- 408.35	- 1.44	+ 6	57.0	- 27.8	5	18	22.4
	12 MO	-23 3 3	- 266	- 409.79	- 1.31	+ 6	29.2	- 28.1	5	22	18.9
	13 TU	-23 7 29	- 237	- 411.10	- 1.18	+ 6	1.1	- 28.4	5	26	15.5
	14 WE	-23 11 26	- 210	- 412.28	- 1.03	+ 5	32.6	- 28.7	5	30	12.0
	15 TH	-23 14 56	- 182	- 413.31	- 0.90	+ 5	3.5	- 29.0	5	34	8.6
	16 FR	-23 17 58	- 155	- 414.21	- 0.77	+ 4	34.9	- 29.2	5	38	5.2
	17 SA	-23 20 33	- 126	- 414.98	- 0.62	+ 4	5.8	- 29.4	5	42	1.7
	18 SU	-23 22 39	- 98	- 415.60	- 0.48	+ 3	36.4	- 29.5	5	45	58.3
	19 MO	-23 24 17	- 70	- 416.08	- 0.35	+ 3	6.5	- 29.6	5	49	54.8
	20 TU	-23 25 27	- 42	- 416.43	- 0.20	+ 2	37.2	- 29.7	5	53	51.4
	21 WE	-23 26 9	- 13	- 416.63	- 0.07	+ 2	7.5	- 29.8	5	57	47.9
	22 TH	-23 26 22	+ 15	- 416.70	+ 0.07	+ 1	37.7	- 29.8	6	1	44.5
	23 FR	-23 26 7	+ 43	- 416.63	+ 0.21	+ 1	7.9	- 29.8	6	5	41.0
	24 SA	-23 25 24	+ 71	- 416.42	+ 0.36	+ 0	38.2	- 29.7	6	9	37.6
	25 SU	-23 24 13	+ 99	- 416.06	+ 0.49	+ 0	8.4	- 29.7	6	13	34.2
	26 MO	-23 22 34	+ 128	- 415.57	+ 0.63	- 0	21.2	- 29.6	6	17	30.7
	27 TU	-23 20 26	+ 156	- 414.94	+ 0.77	- 0	50.8	- 29.4	6	21	27.3
	28 WE	-23 17 50	+ 184	- 414.17	+ 0.90	- 1	20.2	- 29.3	6	25	23.8
	29 TH	-23 14 46	+ 212	- 413.27	+ 1.05	- 1	49.5	- 29.1	6	29	20.4
	30 FR	-23 11 14	+ 239	- 412.22	+ 1.18	- 2	18.6	- 28.8	6	33	17.0
	31 SA	-23 7 15	+ 268	- 411.04	+ 1.33	- 2	47.4	- 28.6	6	37	13.5
	32 SU	-23 2 47		- 409.71		- 3	16.0		6	41	10.1

Daily Change in Equation of Time (seconds)

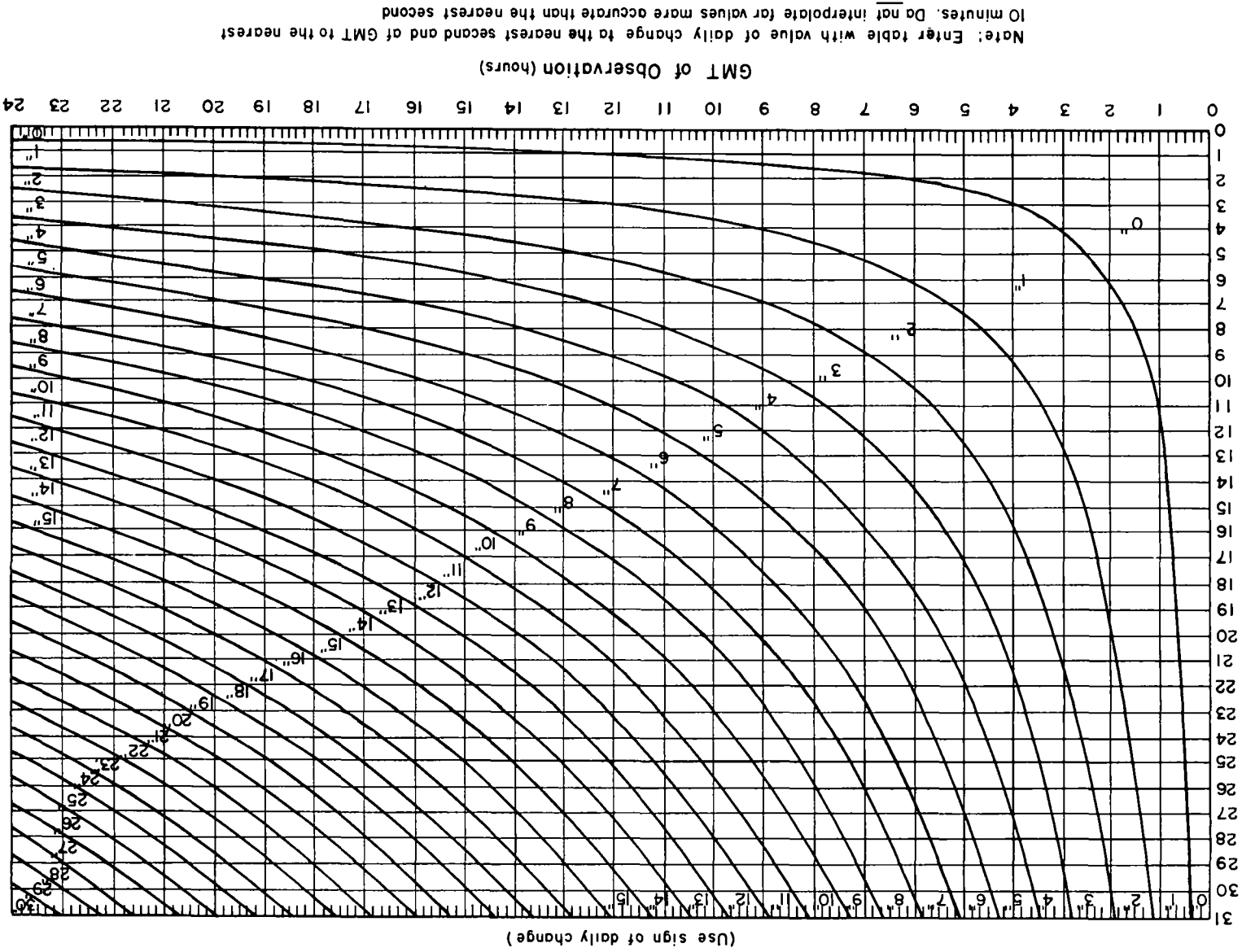


Table 3. Equation of Time Graph
EQUATION OF TIME--PARTIAL DAY IN SECONDS
(Use sign of daily change)

Table 4. Correction to Greenwich Mean Time Interval to Obtain Greenwich Sidereal Time Interval

GMT	0 ^h	1 ^h	2 ^h	3 ^h	4 ^h	5 ^h	6 ^h	7 ^h	8 ^h	9 ^h	10 ^h	11 ^h
m	m s	m s	m s	m s	m s	m s	m s	m s	m s	m s	m s	m s
0	0 0.0	0 9.0	0 19.7	0 29.6	0 39.4	0 49.3	0 59.1	1 9.0	1 18.9	1 28.7	1 38.6	1 48.4
1	0.2	10.0	19.9	29.7	39.6	49.4	59.3	9.2	19.0	28.9	38.7	48.6
2	0.3	10.2	20.0	29.9	39.8	49.6	59.5	9.3	19.2	29.0	38.9	48.8
3	0.5	10.3	20.2	30.1	39.9	49.8	59.6	9.5	19.3	29.2	39.1	48.9
4	0.7	10.5	20.4	30.2	40.1	49.9	59.8	9.7	19.5	29.4	39.2	49.1
5	0 0.8	0 10.7	0 20.5	0 30.4	0 40.2	0 50.1	1 0.0	1 0.8	1 10.7	1 20.5	1 30.4	1 40.2
6	1.0	10.8	20.7	30.6	40.4	50.3	0.1	10.0	19.8	29.7	39.6	49.4
7	1.2	11.0	20.9	30.7	40.6	50.4	0.3	10.1	20.0	29.9	39.7	49.6
8	1.3	11.2	21.0	30.9	40.7	50.6	0.5	10.3	20.2	30.0	39.9	49.7
9	1.5	11.3	21.2	31.0	40.9	50.8	0.6	10.5	20.3	30.2	40.0	49.9
10	0 1.6	0 11.5	0 21.4	0 31.2	0 41.1	0 50.9	1 0.8	1 10.6	1 20.5	1 30.4	1 40.2	1 50.1
11	1.8	11.7	21.5	31.4	41.2	51.1	0.9	10.8	20.7	30.5	40.4	50.2
12	2.0	11.8	21.7	31.5	41.4	51.3	1.1	11.0	20.8	30.7	40.5	50.4
13	2.1	12.0	21.8	31.7	41.6	51.4	1.3	11.1	21.0	30.8	40.7	50.6
14	2.3	12.2	22.0	31.9	41.7	51.6	1.4	11.3	21.2	31.0	40.9	50.7
15	0 2.5	0 12.3	0 22.2	0 32.0	0 41.9	0 51.7	1 1.6	1 11.5	1 21.3	1 31.2	1 41.0	1 50.9
16	2.6	12.5	22.3	32.2	42.1	51.9	1.8	11.6	21.5	31.3	41.2	51.0
17	2.8	12.6	22.5	32.4	42.2	52.1	1.9	11.8	21.6	31.5	41.4	51.2
18	3.0	12.8	22.7	32.5	42.4	52.2	2.1	12.0	21.8	31.7	41.5	51.4
19	3.1	13.0	22.8	32.7	42.5	52.4	2.3	12.1	22.0	31.8	41.7	51.5
20	0 3.3	0 13.1	0 23.0	0 32.9	0 42.7	0 52.6	1 2.4	1 12.3	1 22.1	1 32.0	1 41.8	1 51.7
21	3.4	13.3	23.2	33.0	42.9	52.7	2.6	12.4	22.3	32.2	42.0	51.9
22	3.6	13.5	23.3	33.2	43.0	52.9	2.8	12.6	22.5	32.3	42.2	52.0
23	3.8	13.6	23.5	33.3	43.2	53.1	2.9	12.8	22.6	32.5	42.3	52.2
24	3.9	13.8	23.7	33.5	43.4	53.2	3.1	12.9	22.8	32.7	42.5	52.4
25	0 4.1	0 14.0	0 23.8	0 33.7	0 43.5	0 53.4	1 3.2	1 13.1	1 23.0	1 32.8	1 42.7	1 52.5
26	4.3	14.1	24.0	33.8	43.7	53.6	3.4	13.3	23.1	33.0	42.8	52.7
27	4.4	14.3	24.1	34.0	43.9	53.7	3.6	13.4	23.3	33.1	43.0	52.9
28	4.6	14.5	24.3	34.2	44.0	53.9	3.7	13.6	23.5	33.3	43.2	53.0
29	4.8	14.6	24.5	34.3	44.2	54.0	3.9	13.8	23.6	33.5	43.3	53.2
30	0 4.9	0 14.8	0 24.6	0 34.5	0 44.4	0 54.2	1 4.1	1 13.9	1 23.8	1 33.6	1 43.5	1 53.3
31	5.1	14.9	24.8	34.7	44.5	54.4	4.2	14.1	23.9	33.8	43.7	53.5
32	5.3	15.1	25.0	34.8	44.7	54.5	4.4	14.3	24.1	34.0	43.8	53.7
33	5.4	15.3	25.1	35.0	44.8	54.7	4.6	14.4	24.3	34.1	44.0	53.8
34	5.6	15.4	25.3	35.2	45.0	54.9	4.7	14.6	24.4	34.3	44.2	54.0
35	0 5.8	0 15.6	0 25.5	0 35.3	0 45.2	0 55.0	1 4.0	1 14.7	1 24.6	1 34.5	1 44.3	1 54.2
36	5.9	15.8	25.6	35.5	45.3	55.2	5.1	14.9	24.8	34.6	44.5	54.3
37	6.1	15.9	25.8	35.6	45.5	55.4	5.2	15.1	24.9	34.8	44.6	54.5
38	6.2	16.1	26.0	35.8	45.7	55.5	5.4	15.2	25.1	35.0	44.8	54.7
39	6.4	16.3	26.1	36.0	45.8	55.7	5.5	15.4	25.3	35.1	45.0	54.8
40	0 6.6	0 16.4	0 26.3	0 36.1	0 46.0	0 55.9	1 5.7	1 15.6	1 25.4	1 35.3	1 45.1	1 55.0
41	6.7	16.6	26.4	36.3	46.2	56.0	5.9	15.7	25.6	35.4	45.3	55.2
42	6.9	16.8	26.6	36.5	46.3	56.2	6.0	15.9	25.8	35.6	45.5	55.3
43	7.1	16.9	26.8	36.6	46.5	56.3	6.2	16.1	25.9	35.8	45.6	55.5
44	7.2	17.1	26.9	36.8	46.7	56.5	6.4	16.2	26.1	35.9	45.8	55.6
45	0 7.4	0 17.2	0 27.1	0 37.0	0 46.8	0 56.7	1 6.5	1 16.4	1 26.2	1 36.1	1 46.0	1 55.8
46	7.6	17.4	27.3	37.1	47.0	56.8	6.7	16.6	26.4	36.3	46.1	56.0
47	7.7	17.6	27.4	37.3	47.1	57.0	6.9	16.7	26.6	36.4	46.3	56.1
48	7.9	17.7	27.6	37.5	47.3	57.2	7.0	16.9	26.7	36.6	46.4	56.3
49	8.0	17.9	27.8	37.6	47.5	57.3	7.2	17.0	26.9	36.8	46.6	56.5
50	0 8.2	0 18.1	0 27.9	0 37.8	0 47.6	0 57.5	1 7.4	1 17.2	1 27.1	1 36.9	1 46.8	1 56.6
51	8.4	18.2	28.1	37.9	47.8	57.7	7.5	17.4	27.2	37.1	46.9	56.8
52	8.5	18.4	28.3	38.1	48.0	57.8	7.7	17.5	27.4	37.3	47.1	57.0
53	8.7	18.6	28.4	38.3	48.1	58.0	7.8	17.7	27.6	37.4	47.3	57.1
54	8.9	18.7	28.6	38.4	48.3	58.2	8.0	17.9	27.7	37.6	47.4	57.3
55	0 9.0	0 18.9	0 28.7	0 38.6	0 48.5	0 58.3	1 8.2	1 18.0	1 27.9	1 37.7	1 47.6	1 57.5
56	9.2	19.1	28.9	38.8	48.6	58.5	8.3	18.2	28.1	37.9	47.8	57.6
57	9.4	19.2	29.1	38.9	48.8	58.6	8.5	18.4	28.2	38.1	47.9	57.8
58	9.5	19.4	29.2	39.1	49.0	58.8	8.7	18.5	28.4	38.2	48.1	57.9
59	9.7	19.5	29.4	39.3	49.1	59.0	8.8	18.7	28.5	38.4	48.3	58.1

Table 4. Correction to Greenwich Mean Time Interval to Obtain Greenwich Sidereal Time Interval—Continued

GMT	12 ^h	13 ^h	14 ^h	15 ^h	16 ^h	17 ^h	18 ^h	19 ^h	20 ^h	21 ^h	22 ^h	23 ^h
m	m s	m s	m s	m s	m s	m s	m s	m s	m s	m s	m s	m s
0	1 58.3	2 8.1	2 18.0	2 27.8	2 37.7	2 47.6	2 57.4	3 7.3	3 17.1	3 27.0	3 36.8	3 46.7
1	58.4	8.3	18.2	28.0	37.9	47.7	57.6	7.4	17.3	27.2	37.0	46.9
2	58.6	8.5	18.3	28.2	38.0	47.9	57.7	7.6	17.5	27.3	37.2	47.0
3	58.8	8.6	18.5	28.3	38.2	48.1	57.9	7.8	17.6	27.5	37.3	47.2
4	58.9	8.8	18.6	28.5	38.4	48.2	58.1	7.9	17.8	27.6	37.5	47.4
5	1 59.1	2 9.0	2 18.8	2 28.7	2 38.5	2 48.4	2 58.2	3 8.1	3 18.0	3 27.8	3 37.7	3 47.5
6	59.3	9.1	19.0	28.8	38.7	48.5	58.4	8.3	18.1	28.0	37.8	47.7
7	59.4	9.3	19.1	29.0	38.9	48.7	58.6	8.4	18.3	28.1	38.0	47.8
8	59.6	9.4	19.3	29.2	39.0	48.9	58.7	8.6	18.4	28.3	38.2	48.0
9	59.8	9.6	19.5	29.3	39.2	49.0	58.9	8.8	18.6	28.5	38.3	48.2
10	1 59.9	2 9.8	2 19.6	2 29.5	2 39.3	2 49.2	2 59.1	3 8.9	3 18.8	3 28.6	3 38.5	3 48.3
11	2 0.1	9.9	19.8	29.7	39.5	49.4	59.2	9.1	18.9	28.8	38.6	48.5
12	0.2	10.1	20.0	29.8	39.7	49.5	59.4	9.2	19.1	29.0	38.8	48.7
13	0.4	10.3	20.1	30.0	39.8	49.7	59.6	9.4	19.3	29.1	39.0	48.8
14	0.6	10.4	20.3	30.1	40.0	49.9	59.7	9.6	19.4	29.3	39.1	49.0
15	2 0.7	2 10.6	2 20.5	2 30.3	2 40.2	2 50.0	2 59.9	3 9.7	3 19.6	3 29.4	3 39.3	3 49.2
16	0.9	10.8	20.6	30.5	40.3	50.2	3 0.0	9.9	19.8	29.6	39.5	49.3
17	1.1	10.9	20.8	30.6	40.5	50.4	0.2	10.1	19.9	29.8	39.6	49.5
18	1.2	11.1	20.9	30.8	40.7	50.5	0.4	10.2	20.1	29.9	39.8	49.7
19	1.4	11.3	21.1	31.0	40.8	50.7	0.5	10.4	20.3	30.1	40.0	49.8
20	2 1.6	2 11.4	2 21.3	2 31.1	2 41.0	2 50.8	3 0.7	3 10.6	3 20.4	3 30.3	3 40.1	3 50.0
21	1.7	11.6	21.4	31.3	41.2	51.0	0.9	10.7	20.6	30.4	40.3	50.1
22	1.9	11.7	21.6	31.5	41.3	51.2	1.0	10.9	20.7	30.6	40.5	50.3
23	2.1	11.9	21.8	31.6	41.5	51.3	1.2	11.1	20.9	30.8	40.6	50.5
24	2.2	12.1	21.9	31.8	41.6	51.5	1.4	11.2	21.1	30.9	40.8	50.6
25	2 2.4	2 12.2	2 22.1	2 32.0	2 41.8	2 51.7	3 1.5	3 11.4	3 21.2	3 31.1	3 40.9	3 50.8
26	2.5	12.4	22.3	32.1	42.0	51.8	1.7	11.5	21.4	31.3	41.1	51.0
27	2.7	12.6	22.4	32.3	42.1	52.0	1.9	11.7	21.6	31.4	41.3	51.1
28	2.9	12.7	22.6	32.4	42.3	52.2	2.0	11.9	21.7	31.6	41.4	51.3
29	3 0	12.9	22.8	32.6	42.5	52.3	2.2	12.0	21.9	31.8	41.6	51.5
30	2 3.2	2 13.1	2 22.9	2 32.8	2 42.6	2 52.5	3 2.3	3 12.2	3 22.1	3 31.9	3 41.8	3 51.6
31	3.4	13.2	23.1	32.9	42.8	52.7	2.5	12.4	22.2	32.1	41.9	51.8
32	3.5	13.4	23.2	33.1	43.0	52.8	2.7	12.5	22.4	32.2	42.1	52.0
33	3.7	13.6	23.4	33.3	43.1	53.0	2.8	12.7	22.6	32.4	42.3	52.1
34	3.9	13.7	23.6	33.4	43.3	53.1	3.0	12.9	22.7	32.6	42.4	52.3
35	2 4.0	2 13.9	2 23.7	2 33.6	2 43.5	2 53.3	3 3.2	3 13.0	3 22.9	3 32.7	3 42.6	3 52.4
36	4.2	14.0	23.9	33.8	43.6	53.5	3.3	13.2	23.0	32.9	42.8	52.6
37	4.4	14.2	24.1	33.9	43.8	53.6	3.5	13.4	23.2	33.1	42.9	52.8
38	4.5	14.4	24.2	34.1	43.9	53.8	3.7	13.5	23.4	33.2	43.1	52.9
39	4.7	14.5	24.4	34.3	44.1	54.0	3.8	13.7	23.5	33.4	43.2	53.1
40	2 4.8	2 14.7	2 24.6	2 34.4	2 44.3	2 54.1	3 4.0	3 13.8	3 23.7	3 33.6	3 43.4	3 53.3
41	5.0	14.9	24.7	34.6	44.4	54.3	4.2	14.0	23.9	33.7	43.6	53.4
42	5.2	15.0	24.9	34.7	44.6	54.5	4.3	14.2	24.0	33.9	43.7	53.6
43	5.3	15.2	25.1	34.9	44.8	54.6	4.5	14.3	24.2	34.0	43.9	53.8
44	5.5	15.4	25.2	35.1	44.9	54.8	4.6	14.5	24.4	34.2	44.1	53.9
45	2 5.7	2 15.5	2 25.4	2 35.2	2 45.1	2 55.0	3 4.8	3 14.7	3 24.5	3 34.4	3 44.2	3 54.1
46	5.8	15.7	25.5	35.4	45.3	55.1	5.0	14.8	24.7	34.5	44.4	54.3
47	6.0	15.9	25.7	35.6	45.4	55.3	5.1	15.0	24.8	34.7	44.6	54.4
48	6.2	16.0	25.9	35.7	45.6	55.4	5.3	15.2	25.0	34.9	44.7	54.6
49	6.3	16.2	26.0	35.9	45.8	55.6	5.5	15.3	25.2	35.0	44.9	54.7
50	2 6.5	2 16.3	2 26.2	2 36.1	2 45.9	2 55.8	3 5.6	3 15.5	3 25.3	3 35.2	3 45.1	3 54.9
51	6.7	16.5	26.4	36.2	46.1	55.9	5.8	15.7	25.5	35.4	45.2	55.1
52	6.8	16.7	26.5	36.4	46.2	56.1	6.0	15.8	25.7	35.5	45.4	55.2
53	7.0	16.8	26.7	36.6	46.4	56.3	6.1	16.0	25.8	35.7	45.5	55.4
54	7.1	17 0	26 9	36.7	46.6	56.4	6.3	16 1	26 0	35.9	45.7	55.6
55	2 7.3	2 17.2	2 27.0	2 36.9	2 46.7	2 56.6	3 6.5	3 16.3	3 26.2	3 36.0	3 45.9	3 55.7
56	7.5	17.3	27.2	37.0	46.9	56.8	6.6	16.5	26.3	36.2	46.0	55.9
57	7.6	17.5	27.4	37.2	47.1	56.9	6.8	16.6	26.5	36.4	46.2	56.1
58	7.8	17.7	27.5	37.4	47.2	57.1	6.9	16.8	26.7	36.5	46.4	56.2
59	8 0	17.8	27.7	37 5	47.4	57.3	7.1	17 0	26 8	36.7	46.5	56.4

Table 8a. Conversion of Time to Arc

Time				Arc				Time				Arc			
Hours				Miles				Min				Miles			
	°				'								'		
1	15	266.67	1	0	15	4.44	21	5	15	93.33	41	10	15	182.22	
2	30	533.33	2	0	30	8.89	22	5	30	97.78	42	10	30	186.67	
3	45	800.00	3	0	45	13.33	23	5	45	102.22	43	10	45	191.11	
4	60	1066.67	4	1	00	17.78	24	6	00	106.67	44	11	00	195.56	
5	75	1333.33	5	1	15	22.22	25	6	15	111.11	45	11	15	200.00	
6	90	1600.00	6	1	30	26.67	26	6	30	115.56	46	11	30	204.44	
7	105	1866.67	7	1	45	31.11	27	6	45	120.00	47	11	45	208.89	
8	120	2133.33	8	2	00	35.56	28	7	00	124.44	48	12	00	213.33	
9	135	2400.00	9	2	15	40.00	29	7	15	128.89	49	12	15	217.78	
10	150	2666.67	10	2	30	44.44	30	7	30	133.33	50	12	30	222.22	
11	165	2933.33	11	2	45	48.89	31	7	45	137.78	51	12	45	226.67	
12	180	3200.00	12	3	00	53.33	32	8	00	142.22	52	13	00	231.11	
13	195	3466.67	13	3	15	57.78	33	8	15	146.67	53	13	15	235.56	
14	210	3733.33	14	3	30	62.22	34	8	30	151.11	54	13	30	240.00	
15	225	4000.00	15	3	45	66.67	35	8	45	155.56	55	13	45	244.44	
16	240	4266.67	16	4	00	71.11	36	9	00	160.00	56	14	00	248.89	
17	255	4533.33	17	4	15	75.56	37	9	15	164.44	57	14	15	253.33	
18	270	4800.00	18	4	30	80.00	38	9	30	168.89	58	14	30	257.78	
19	285	5066.67	19	4	45	84.44	39	9	45	173.33	59	14	45	262.22	
20	300	5333.33	20	5	00	88.89	40	10	00	177.78	60	15	00	266.67	
21	315	5600.00													
22	330	5866.67													
23	345	6133.33													
24	360	6400.00													

Time				Arc				Time				Arc			
Sec				Miles				Sec				Miles			
	'														
1	0	15	.07	16	4	00	1.19	31	7	45	2.30	46	11	30	3.41
2	0	30	.15	17	4	15	1.26	32	8	00	2.37	47	11	45	3.48
3	0	45	.22	18	4	30	1.33	33	8	15	2.44	48	12	00	3.56
4	1	00	.30	19	4	45	1.41	34	8	30	2.52	49	12	15	3.63
5	1	15	.37	20	5	00	1.48	35	8	45	2.59	50	12	30	3.70
6	1	30	.44	21	5	15	1.56	36	9	00	2.67	51	12	45	3.78
7	1	45	.52	22	5	30	1.63	37	9	15	2.74	52	13	00	3.85
8	2	00	.59	23	5	45	1.70	37	9	30	2.81	53	13	15	3.93
9	2	15	.67	24	6	00	1.78	39	9	45	2.89	54	13	30	4.00
10	2	30	.74	25	6	15	1.85	40	10	00	2.96	55	13	45	4.07
11	2	45	.81	26	6	30	1.93	41	10	15	3.04	56	14	00	4.15
12	3	00	.89	27	6	45	2.00	42	10	30	3.11	57	14	15	4.22
13	3	15	.96	28	7	00	2.07	43	10	45	3.19	58	14	30	4.30
14	3	30	1.04	29	7	15	2.15	44	11	00	3.26	59	14	45	4.37
15	3	45	1.11	30	7	30	2.22	45	11	15	3.33	60	15	00	4.44

Example: Time is 22 hours, 46 minutes, 37 seconds. Convert to arc.

22 hours time = 330° arc
 46 minutes time = 11° 30' arc
 37 seconds time = 9' 15" arc

22° 46' 37" 341° 39' 15" arc

Table 5b. Conversion of Arc to Time

DEGREES						MINUTES			SECONDS					
°	'	"	°	'	"	°	'	"	°	'	"	°	'	"
0	0	00	60	4	00	120	8	00	0	0	00	0	0	00
1	0	04	61	4	04	121	8	04	1	0	04	1	0	04
2	0	08	62	4	08	122	8	08	2	0	08	2	0	08
3	0	12	63	4	12	123	8	12	3	0	12	3	0	12
4	0	16	64	4	16	124	8	16	4	0	16	4	0	16
5	0	20	65	4	20	125	8	20	5	0	20	5	0	20
6	0	24	66	4	24	126	8	24	6	0	24	6	0	24
7	0	28	67	4	28	127	8	28	7	0	28	7	0	28
8	0	32	68	4	32	128	8	32	8	0	32	8	0	32
9	0	36	69	4	36	129	8	36	9	0	36	9	0	36
10	0	40	70	4	40	130	8	40	10	0	40	10	0	40
11	0	44	71	4	44	131	8	44	11	0	44	11	0	44
12	0	48	72	4	48	132	8	48	12	0	48	12	0	48
13	0	52	73	4	52	133	8	52	13	0	52	13	0	52
14	0	56	74	4	56	134	8	56	14	0	56	14	0	56
15	1	00	75	5	00	135	9	00	15	1	00	15	1	00
16	1	04	76	5	04	136	9	04	16	1	04	16	1	04
17	1	08	77	5	08	137	9	08	17	1	08	17	1	08
18	1	12	78	5	12	138	9	12	18	1	12	18	1	12
19	1	16	79	5	16	139	9	16	19	1	16	19	1	16
20	1	20	80	5	20	140	9	20	20	1	20	20	1	20
21	1	24	81	5	24	141	9	24	21	1	24	21	1	24
22	1	28	82	5	28	142	9	28	22	1	28	22	1	28
23	1	32	83	5	32	143	9	32	23	1	32	23	1	32
24	1	36	84	5	36	144	9	36	24	1	36	24	1	36
25	1	40	85	5	40	145	9	40	25	1	40	25	1	40
26	1	44	86	5	44	146	9	44	26	1	44	26	1	44
27	1	48	87	5	48	147	9	48	27	1	48	27	1	48
28	1	52	88	5	52	148	9	52	28	1	52	28	1	52
29	1	56	89	5	56	149	9	56	29	1	56	29	1	56
30	2	00	90	6	00	150	10	00	30	2	00	30	2	00
31	2	04	91	6	04	151	10	04	31	2	04	31	2	04
32	2	08	92	6	08	152	10	08	32	2	08	32	2	08
33	2	12	93	6	12	153	10	12	33	2	12	33	2	12
34	2	16	94	6	16	154	10	16	34	2	16	34	2	16
35	2	20	95	6	20	155	10	20	35	2	20	35	2	20
36	2	24	96	6	24	156	10	24	36	2	24	36	2	24
37	2	28	97	6	28	157	10	28	37	2	28	37	2	28
38	2	32	98	6	32	158	10	32	38	2	32	38	2	32
39	2	36	99	6	36	159	10	36	39	2	36	39	2	36
40	2	40	100	6	40	160	10	40	40	2	40	40	2	40
41	2	44	101	6	44	161	10	44	41	2	44	41	2	44
42	2	48	102	6	48	162	10	48	42	2	48	42	2	48
43	2	52	103	6	52	163	10	52	43	2	52	43	2	52
44	2	56	104	6	56	164	10	56	44	2	56	44	2	56
45	3	00	105	7	00	165	11	00	45	3	00	45	3	00
46	3	04	106	7	04	166	11	04	46	3	04	46	3	04
47	3	08	107	7	08	167	11	08	47	3	08	47	3	08
48	3	12	108	7	12	168	11	12	48	3	12	48	3	12
49	3	16	109	7	16	169	11	16	49	3	16	49	3	16
50	3	20	110	7	20	170	11	20	50	3	20	50	3	20
51	3	24	111	7	24	171	11	24	51	3	24	51	3	24
52	3	28	112	7	28	172	11	28	52	3	28	52	3	28
53	3	32	113	7	32	173	11	32	53	3	32	53	3	32
54	3	36	114	7	36	174	11	36	54	3	36	54	3	36
55	3	40	115	7	40	175	11	40	55	3	40	55	3	40
56	3	44	116	7	44	176	11	44	56	3	44	56	3	44
57	3	48	117	7	48	177	11	48	57	3	48	57	3	48
58	3	52	118	7	52	178	11	52	58	3	52	58	3	52
59	3	56	119	7	56	179	11	56	59	3	56	59	3	56

90° - 6"

180° - 12"

270° - 18"

Table 5c. Conversion of Degrees, Minutes, and Seconds to Mils

Degrees											
Deg	Mils	Deg	Mils	Deg	Mils	Deg	Mils	Deg	Mils	Deg	Mils
1	17.78	31	551.11	61	1084.44	91	1617.78	121	2151.11	151	2684.44
2	35.56	32	568.89	62	1102.22	92	1635.56	122	2168.89	152	2702.22
3	53.33	33	586.67	63	1120.00	93	1653.33	123	2186.67	153	2720.00
4	71.11	34	604.44	64	1137.78	94	1671.11	124	2204.44	154	2737.78
5	88.89	35	622.22	65	1155.56	95	1688.89	125	2222.22	155	2755.56
6	106.67	36	640.00	66	1173.33	96	1706.67	126	2240.00	156	2773.33
7	124.44	37	657.78	67	1191.11	97	1724.44	127	2257.78	157	2791.11
8	142.22	38	675.56	68	1208.89	98	1742.22	128	2275.56	158	2808.89
9	160.00	39	693.33	69	1226.67	99	1760.00	129	2293.33	159	2826.67
10	177.78	40	711.11	70	1244.44	100	1777.78	130	2311.11	160	2844.44
11	195.56	41	728.89	71	1262.22	101	1795.56	131	2328.89	161	2862.22
12	213.33	42	746.67	72	1280.00	102	1813.33	132	2346.67	162	2880.00
13	231.11	43	764.44	73	1297.78	103	1831.11	133	2364.44	163	2897.78
14	248.89	44	782.22	74	1315.56	104	1848.89	134	2382.22	164	2915.56
15	266.67	45	800.00	75	1333.33	105	1866.67	135	2400.00	165	2933.33
16	284.44	46	817.78	76	1351.11	106	1884.44	136	2417.78	166	2951.11
17	302.22	47	835.56	77	1368.89	107	1902.22	137	2435.56	167	2968.89
18	320.00	48	853.33	78	1386.67	108	1920.00	138	2453.33	168	2986.67
19	337.78	49	871.11	79	1404.44	109	1937.78	139	2471.11	169	3004.44
20	355.56	50	888.89	80	1422.22	110	1955.56	140	2488.89	170	3022.22
21	373.33	51	906.67	81	1440.00	111	1973.33	141	2506.67	171	3040.00
22	391.11	52	924.44	82	1457.78	112	1991.11	142	2524.44	172	3057.78
23	408.89	53	942.22	83	1475.56	113	2008.89	143	2542.22	173	3075.56
24	426.67	54	960.00	84	1493.33	114	2026.67	144	2560.00	174	3093.33
25	444.44	55	977.78	85	1511.11	115	2044.44	145	2577.78	175	3111.11
26	462.22	56	995.56	86	1528.89	116	2062.22	146	2595.56	176	3128.89
27	480.00	57	1013.33	87	1546.67	117	2080.00	147	2613.33	177	3146.67
28	497.78	58	1031.11	88	1564.44	118	2097.78	148	2631.11	178	3164.44
29	515.56	59	1048.89	89	1582.22	119	2115.56	149	2648.89	179	3182.22
30	533.33	60	1066.67	90	1600.00	120	2133.33	150	2666.67	180	3200.00

Minutes						Seconds					
Min	Mils	Min	Mils	Min	Mils	Sec	Mils	Sec	Mils	Sec	Mils
1	0.30	21	6.22	41	12.15	1	0.00	21	0.10	41	0.20
2	0.59	22	6.52	42	12.44	2	0.01	22	0.11	42	0.21
3	0.89	23	6.81	43	12.74	3	0.01	23	0.11	43	0.21
4	1.19	24	7.11	44	13.04	4	0.02	24	0.12	44	0.22
5	1.48	25	7.41	45	13.33	5	0.02	25	0.12	45	0.22
6	1.78	26	7.70	46	13.63	6	0.03	26	0.13	46	0.23
7	2.07	27	8.00	47	13.93	7	0.03	27	0.13	47	0.23
8	2.37	28	8.30	48	14.22	8	0.04	28	0.14	48	0.24
9	2.67	29	8.59	49	14.52	9	0.04	29	0.14	49	0.24
10	2.96	30	8.89	50	14.81	10	0.05	30	0.15	50	0.25
11	3.26	31	9.19	51	15.11	11	0.05	31	0.15	51	0.25
12	3.56	32	9.48	52	15.41	12	0.06	32	0.16	52	0.26
13	3.85	33	9.78	53	15.70	13	0.06	33	0.16	53	0.26
14	4.15	34	10.07	54	16.00	14	0.07	34	0.17	54	0.27
15	4.44	35	10.37	55	16.30	15	0.07	35	0.17	55	0.27
16	4.74	36	10.67	56	16.59	16	0.08	36	0.18	56	0.28
17	5.04	37	10.96	57	16.89	17	0.08	37	0.18	57	0.28
18	5.33	38	11.26	58	17.19	18	0.09	38	0.19	58	0.29
19	5.63	39	11.56	59	17.48	19	0.09	39	0.19	59	0.29
20	5.93	40	11.85	60	17.78	20	0.10	40	0.20	60	0.30

Table 6. Convergence

Northing = UTM grid northing coordinate of station in meters.

If in Northern Hemisphere, enter table with northing.

If in Southern Hemisphere, subtract northing of station from 10,000,000; enter table with resulting northing.

Enter table using northing to nearest 100 meters and interpolate.

Log XV = Log of function XV (sign always +).

Northing	Function XV	Diff.	Log XV	Diff.	Northing	Function XV	Diff.	Log XV	Diff.
0	0	5.109	0	70834	310,000	1585.0	51.2	3.20003	1426
1,000	5.109	5.109	0.70834	30103	320,000	1636.3	51.3	3.21386	1383
2,000	10.218	5.109	1.00937	17609	330,000	1687.5	51.2	3.22724	1338
3,000	15.327	5.109	1.18546	12494	340,000	1738.7	51.2	3.24022	1298
4,000	20.436	5.109	1.31040		350,000	1789.9	51.2	3.25283	1261
		5.109		9691					
5,000	25.545	5.109	1.40731	7918	360,000	1841.2	51.3	3.26510	1227
6,000	30.654	5.109	1.48649	6604	370,000	1892.4	51.2	3.27701	1191
7,000	35.763	5.109	1.55343	5800	380,000	1943.7	51.3	3.28863	1162
8,000	40.872	5.109	1.61143	5115	390,000	1995.0	51.3	3.29994	1131
9,000	45.981	5.109	1.66258		400,000	2046.3	51.3	3.31097	1103
		5.109		4576					
10,000	51.090	51.09	1.70834	30103	410,000	2097.6	51.3	3.32172	1075
20,000	102.18	51.09	2.00937	17609	420,000	2148.9	51.3	3.33222	1050
30,000	153.27	51.09	2.18546	12494	430,000	2200.2	51.3	3.34246	1024
40,000	204.36	51.09	2.31040	9692	440,000	2251.5	51.3	3.35247	1001
50,000	255.46	51.10	2.40732		450,000	2302.9	51.4	3.36228	981
		51.09		7918					
60,000	306.55	51.10	2.48650	6696	460,000	2354.2	51.3	3.37184	956
70,000	357.65	51.09	2.55346	5799	470,000	2405.6	51.4	3.38122	938
80,000	408.74	51.10	2.61145	5116	480,000	2456.9	51.3	3.39030	917
90,000	459.84	51.10	2.66261	4576	490,000	2508.3	51.4	3.39938	899
100,000	510.94	51.10	2.70837		500,000	2559.7	51.4	3.40819	881
		51.11		4141					
110,000	562.05	51.10	2.74978	3779	510,000	2611.1	51.4	3.41682	863
120,000	613.15	51.11	2.78757	3477	520,000	2662.6	51.5	3.42531	849
130,000	664.26	51.12	2.82234	3220	530,000	2714.0	51.4	3.43361	830
140,000	715.38	51.11	2.85454	2997	540,000	2765.4	51.4	3.44176	815
150,000	766.49	51.12	2.88451		550,000	2816.9	51.5	3.44977	801
		51.13		2804					
160,000	817.61	51.13	2.91255	2634	560,000	2868.4	51.5	3.45764	787
170,000	868.74	51.13	2.93880	2484	570,000	2919.9	51.5	3.46537	773
180,000	919.87	51.13	2.96373	2349	580,000	2971.4	51.5	3.47296	759
190,000	971.00	51.1	2.98722	2227	590,000	3022.9	51.5	3.48042	746
200,000	1022.1	51.2	3.00949		600,000	3074.4	51.6	3.48776	734
		51.1		2123					
210,000	1073.3	51.1	3.03072	2020	610,000	3126.0	51.5	3.49499	723
220,000	1124.4	51.2	3.05092	1934	620,000	3177.5	51.6	3.50209	710
230,000	1175.6	51.1	3.07026	1848	630,000	3229.1	51.6	3.50908	699
240,000	1226.7	51.2	3.08874	1776	640,000	3280.7	51.6	3.51597	689
250,000	1277.9	51.2	3.10650		650,000	3332.3	51.7	3.52274	677
		51.2		1706					
260,000	1329.1	51.1	3.12356	1641	660,000	3384.0	51.7	3.52943	669
270,000	1380.3	51.2	3.13907	1579	670,000	3435.6	51.7	3.53600	657
280,000	1431.4	51.2	3.15576	1526	680,000	3487.3	51.7	3.54249	649
290,000	1482.6	51.2	3.17102	1475	690,000	3539.0	51.7	3.54888	639
300,000	1533.8	51.2	3.18577		700,000	3590.7	51.7	3.55518	630

Table 8. Convergence—Continued

Northing	Function XV	Diff.	Log XV	Diff.	Northing	Function XV	Diff.	Log XV	Diff.
700,000	3500.7	51.7	3.55518	630					
710,000	3642.4	51.7	3.56139	621	1,160,000	5092.3	52.8	3.77750	384
720,000	3694.1	51.7	3.56751	612	1,170,000	6045.1	52.8	3.78140	381
730,000	3745.9	51.8	3.57356	605	1,180,000	6098.0	52.9	3.78510	379
740,000	3797.6	51.7	3.57951	595	1,190,000	6150.9	52.9	3.78894	375
750,000	3849.4	51.8	3.58539	588	1,200,000	6203.8	52.9	3.79266	372
760,000	3901.2	51.8	3.59120	581	1,210,000	6256.7	52.9	3.79635	369
770,000	3953.1	51.9	3.59694	574	1,220,000	6309.7	53.0	3.80001	366
780,000	4004.9	51.8	3.60259	565	1,230,000	6362.7	53.0	3.80364	363
790,000	4056.8	51.9	3.60818	559	1,240,000	6415.8	53.1	3.80725	361
800,000	4108.7	51.9	3.61370	552	1,250,000	6468.8	53.0	3.81082	357
810,000	4160.6	51.9	3.61916	546	1,260,000	6521.9	53.1	3.81437	355
820,000	4212.5	51.9	3.62454	538	1,270,000	6575.1	53.2	3.81790	353
830,000	4264.4	51.9	3.62986	532	1,280,000	6628.3	53.2	3.82140	350
840,000	4316.4	52.0	3.63512	526	1,290,000	6681.5	53.2	3.82487	347
850,000	4368.4	52.0	3.64032	520	1,300,000	6734.7	53.2	3.82832	345
860,000	4420.4	52.0	3.64546	514	1,310,000	6788.0	53.3	3.83174	342
870,000	4472.5	52.1	3.65055	509	1,320,000	6841.3	53.3	3.83514	340
880,000	4524.5	52.0	3.65557	502	1,330,000	6894.7	53.4	3.83852	338
890,000	4576.6	52.1	3.66054	497	1,340,000	6948.0	53.3	3.84186	334
900,000	4628.7	52.1	3.66546	492	1,350,000	7001.5	53.5	3.84519	333
910,000	4680.8	52.1	3.67032	486	1,360,000	7054.9	53.4	3.84849	330
920,000	4733.0	52.2	3.67514	482	1,370,000	7108.4	53.5	3.85177	328
930,000	4785.2	52.2	3.67990	476	1,380,000	7161.9	53.5	3.85503	326
940,000	4837.3	52.1	3.68460	470	1,390,000	7215.5	53.6	3.85827	324
950,000	4889.6	52.3	3.68927	467	1,400,000	7269.1	53.6	3.86148	321
960,000	4941.8	52.2	3.69389	462	1,410,000	7322.7	53.6	3.86467	319
970,000	4994.1	52.3	3.69846	457	1,420,000	7376.4	53.7	3.86784	317
980,000	5046.4	52.3	3.70298	452	1,430,000	7430.1	53.7	3.87099	315
990,000	5098.7	52.3	3.70746	448	1,440,000	7483.9	53.8	3.87413	314
1,000,000	5151.1	52.4	3.71190	444	1,450,000	7537.7	53.8	3.87724	311
1,010,000	5203.4	52.3	3.71629	439	1,460,000	7591.5	53.8	3.88033	309
1,020,000	5255.8	52.4	3.72064	435	1,470,000	7645.4	53.9	3.88340	307
1,030,000	5308.2	52.4	3.72495	431	1,480,000	7699.3	53.9	3.88645	305
1,040,000	5360.7	52.5	3.72922	427	1,490,000	7753.2	53.9	3.88948	303
1,050,000	5413.2	52.5	3.73345	423	1,500,000	7807.2	54.0	3.89250	302
1,060,000	5465.7	52.5	3.73765	420	1,510,000	7861.2	54.0	3.89549	299
1,070,000	5518.2	52.5	3.74180	415	1,520,000	7915.3	54.1	3.89847	298
1,080,000	5570.8	52.6	3.74592	412	1,530,000	7969.4	54.1	3.90143	296
1,090,000	5623.4	52.6	3.75000	408	1,540,000	8023.6	54.2	3.90437	294
1,100,000	5676.0	52.6	3.75404	404	1,550,000	8077.8	54.2	3.90729	292
1,110,000	5728.6	52.6	3.75805	401	1,560,000	8132.0	54.2	3.91020	291
1,120,000	5781.3	52.7	3.76203	398	1,570,000	8186.3	54.3	3.91309	289
1,130,000	5834.0	52.7	3.76597	394	1,580,000	8240.6	54.3	3.91596	287
1,140,000	5886.7	52.7	3.76987	390	1,590,000	8294.9	54.3	3.91881	285
1,150,000	5939.5	52.8	3.77375	388	1,600,000	8349.3	54.4	3.92165	284

Table 6. Convergence—Continued

Northing	Function XV	Diff.	Log XV	Diff.	Northing	Function XV	Diff.	Log XV	Diff.
1,600,000	8349.3	54.4	3.92165	284					
1,610,000	8403.8	54.5	3.92448	283	2,060,000	10004	56	4.03750	224
1,620,000	8458.3	54.5	3.92728	280	2,070,000	10961	57	4.03985	226
1,630,000	8512.8	54.5	3.93007	279	2,080,000	11018	57	4.04210	225
1,640,000	8567.4	54.6	3.93285	278	2,090,000	11075	57	4.04434	224
1,650,000	8622.0	54.6	3.93561	276	2,100,000	11132	57	4.04657	223
1,660,000	8676.7	54.7	3.93835	274	2,110,000	11189	57	4.04879	222
1,670,000	8731.4	54.7	3.94108	273	2,120,000	11246	57	4.05100	221
1,680,000	8786.2	54.8	3.94380	272	2,130,000	11303	57	4.05319	219
1,690,000	8841.0	54.8	3.94650	270	2,140,000	11361	58	4.05542	223
1,700,000	8895.9	54.9	3.94919	269	2,150,000	11418	57	4.05759	217
1,710,000	8950.8	54.9	3.95186	267	2,160,000	11475	57	4.05975	216
1,720,000	9005.7	54.9	3.95452	266	2,170,000	11533	58	4.06194	219
1,730,000	9060.7	55.0	3.95716	264	2,180,000	11590	57	4.06408	214
1,740,000	9115.7	55.0	3.95979	263	2,190,000	11648	58	4.06625	217
1,750,000	9170.8	55.1	3.96241	262	2,200,000	11705	57	4.06837	212
1,760,000	9226.0	55.2	3.96501	260	2,210,000	11763	58	4.07052	215
1,770,000	9281.2	55.2	3.96760	259	2,220,000	11821	58	4.07265	213
1,780,000	9336.4	55.2	3.97018	258	2,230,000	11879	58	4.07478	213
1,790,000	9391.7	55.3	3.97274	256	2,240,000	11937	58	4.07690	212
1,800,000	9447.0	55.3	3.97529	255	2,250,000	11995	58	4.07900	210
1,810,000	9502.4	55.4	3.97783	254	2,260,000	12053	58	4.08110	210
1,820,000	9557.9	55.5	3.98036	253	2,270,000	12111	58	4.08318	208
1,830,000	9613.4	55.5	3.98288	252	2,280,000	12169	58	4.08525	207
1,840,000	9668.9	55.5	3.98538	250	2,290,000	12227	58	4.08732	207
1,850,000	9724.5	55.6	3.98787	249	2,300,000	12285	58	4.08938	206
1,860,000	9780.1	55.6	3.99034	247	2,310,000	12344	59	4.09146	208
1,870,000	9835.8	55.7	3.99281	247	2,320,000	12402	58	4.09340	203
1,880,000	9891.0	55.8	3.99527	246	2,330,000	12461	59	4.09555	206
1,890,000	9947.4	55.8	3.99771	244	2,340,000	12519	58	4.09757	202
1,900,000	10008	55.6	4.00013	242	2,350,000	12578	59	4.09961	204
1,910,000	10050	56	4.00255	242	2,360,000	12636	58	4.10161	200
1,920,000	10115	56	4.00497	242	2,370,000	12695	59	4.10363	202
1,930,000	10171	56	4.00738	239	2,380,000	12754	59	4.10565	202
1,940,000	10227	56	4.00975	239	2,390,000	12813	59	4.10765	200
1,950,000	10283	56	4.01212	237	2,400,000	12872	59	4.10965	200
1,960,000	10339	56	4.01448	236	2,410,000	12931	59	4.11163	198
1,970,000	10396	57	4.01687	239	2,420,000	12990	59	4.11361	198
1,980,000	10452	56	4.01920	233	2,430,000	13049	59	4.11558	197
1,990,000	10508	56	4.02152	232	2,440,000	13109	60	4.11757	199
2,000,000	10565	57	4.02387	235	2,450,000	13168	59	4.11952	195
2,010,000	10621	56	4.02617	230	2,460,000	13228	60	4.12140	197
2,020,000	10678	57	4.02849	232	2,470,000	13287	59	4.12343	194
2,030,000	10734	56	4.03070	227	2,480,000	13347	60	4.12538	195
2,040,000	10791	57	4.03300	230	2,490,000	13406	59	4.12730	192
2,050,000	10848	57	4.03535	229	2,500,000	13466	60	4.12924	194

Table 6. Convergence—Continued

Northing	Function XV	Diff.	Log XV	Diff.	Northing	Function XV	Diff.	Log XV	Diff.
2,500,000	13466	60	4.12924	194					
		60		193			63		168
2,510,000	13526	60	4.13117	192	2,960,000	16305	64	4.21232	170
2,520,000	13586	60	4.13309	192	2,970,000	16369	64	4.21402	170
2,530,000	13646	60	4.13501	190	2,980,000	16433	64	4.21572	168
2,540,000	13706	60	4.13691	190	2,990,000	16497	64	4.21740	169
2,550,000	13766	60	4.13881	189	3,000,000	16561	64	4.21909	170
		60		188			65		167
2,560,000	13826	60	4.14070	190	3,010,000	16626	64	4.22079	168
2,570,000	13886	61	4.14258	187	3,020,000	16690	65	4.22246	166
2,580,000	13947	60	4.14448	188	3,030,000	16755	64	4.22414	166
2,590,000	14007	61	4.14635	185	3,040,000	16819	65	4.22580	168
2,600,000	14068	61	4.14823	185	3,050,000	16884	65	4.22748	166
		60		187			65		167
2,610,000	14128	61	4.15008	186	3,060,000	16949	65	4.22914	165
2,620,000	14189	61	4.15195	186	3,070,000	17014	65	4.23081	165
2,630,000	14250	61	4.15381	185	3,080,000	17079	65	4.23246	165
2,640,000	14311	61	4.15567	184	3,090,000	17144	65	4.23411	165
2,650,000	14372	61	4.15752	184	3,100,000	17209	65	4.23576	163
		61		183			66		166
2,660,000	14433	61	4.15936	182	3,110,000	17274	66	4.23739	165
2,670,000	14494	61	4.16119	182	3,120,000	17340	66	4.23905	162
2,680,000	14555	61	4.16301	182	3,130,000	17406	65	4.24070	162
2,690,000	14616	62	4.16483	184	3,140,000	17471	66	4.24232	164
2,700,000	14678	62	4.16667	180	3,150,000	17537	66	4.24396	163
		61		182			66		162
2,710,000	14739	62	4.16847	179	3,160,000	17603	66	4.24559	162
2,720,000	14801	61	4.17029	181	3,170,000	17669	66	4.24721	162
2,730,000	14862	62	4.17208	180	3,180,000	17735	66	4.24883	161
2,740,000	14924	62	4.17389	178	3,190,000	17801	67	4.25044	164
2,750,000	14986	62	4.17569	179	3,200,000	17868	66	4.25208	160
		62		178			67		162
2,760,000	15048	62	4.17748	178	3,210,000	17934	66	4.25368	159
2,770,000	15110	62	4.17926	177	3,220,000	18001	67	4.25530	160
2,780,000	15172	62	4.18104	177	3,230,000	18067	67	4.25689	161
2,790,000	15234	62	4.18281	176	3,240,000	18134	67	4.25849	159
2,800,000	15296	62	4.18458	178	3,250,000	18201	67	4.26010	157
		63		175			68		159
2,810,000	15359	63	4.18636	177	3,260,000	18268	68	4.26169	161
2,820,000	15421	63	4.18811	174	3,270,000	18335	67	4.26328	158
2,830,000	15484	62	4.18988	176	3,280,000	18403	68	4.26489	157
2,840,000	15546	63	4.19162	174	3,290,000	18470	68	4.26647	156
2,850,000	15609	63	4.19338	175	3,300,000	18538	67	4.26806	158
		63		173			68		156
2,860,000	15672	63	4.19512	172	3,310,000	18605	68	4.26963	158
2,870,000	15735	63	4.19687	173	3,320,000	18673	68	4.27121	158
2,880,000	15798	63	4.19860	172	3,330,000	18741	68	4.27279	158
2,890,000	15861	63	4.20033	172	3,340,000	18809	68	4.27437	156
2,900,000	15924	63	4.20205	172	3,350,000	18877	68	4.27593	156
		63		173			68		158
2,910,000	15987	64	4.20377	170	3,360,000	18945	69	4.27749	155
2,920,000	16051	63	4.20550	172	3,370,000	19014	69	4.27907	157
2,930,000	16114	64	4.20720	172	3,380,000	19082	68	4.28062	154
2,940,000	16178	64	4.20892	172	3,390,000	19151	68	4.28219	
2,950,000	16242	64	4.21064	172	3,400,000	19219	68	4.28373	

Table 6. Convergence—Continued

Northing	Function XV	Diff.	Log XV	Diff.	Northing	Function XV	Diff.	Log XV	Diff.
3,400,000	19219	68	4.28373	154					
3,410,000	19288	69	4.28529	156	3,860,000	22532	75	4.35280	145
3,420,000	19357	69	4.28684	155	3,870,000	22608	76	4.35426	146
3,430,000	19427	70	4.28841	157	3,880,000	22683	75	4.35570	144
3,440,000	19496	69	4.28995	154	3,890,000	22759	76	4.35715	145
3,450,000	19565	69	4.29148	153	3,900,000	22835	76	4.35860	145
3,460,000	19635	70	4.29303	155	3,910,000	22911	76	4.36004	144
3,470,000	19704	69	4.29455	152	3,920,000	22988	77	4.36150	146
3,480,000	19774	70	4.29609	154	3,930,000	23064	76	4.36293	143
3,490,000	19844	70	4.29763	154	3,940,000	23141	77	4.36438	145
3,500,000	19914	70	4.29916	153	3,950,000	23218	77	4.36582	144
3,510,000	19984	70	4.30068	152	3,960,000	23295	77	4.36726	144
3,520,000	20055	71	4.30222	154	3,970,000	23372	77	4.36870	144
3,530,000	20125	70	4.30374	152	3,980,000	23450	78	4.37014	144
3,540,000	20196	71	4.30527	153	3,990,000	23527	77	4.37157	143
3,550,000	20267	71	4.30679	152	4,000,000	23605	78	4.37300	143
3,560,000	20337	70	4.30829	150	4,010,000	23683	78	4.37444	144
3,570,000	20408	71	4.30980	151	4,020,000	23761	78	4.37586	142
3,580,000	20480	72	4.31133	153	4,030,000	23840	79	4.37731	145
3,590,000	20551	71	4.31283	150	4,040,000	23918	78	4.37872	141
3,600,000	20622	71	4.31433	150	4,050,000	23997	79	4.38016	144
3,610,000	20694	72	4.31584	151	4,060,000	24076	79	4.38158	142
3,620,000	20766	72	4.31735	151	4,070,000	24155	79	4.38301	143
3,630,000	20837	71	4.31884	149	4,080,000	24234	79	4.38443	142
3,640,000	20909	72	4.32033	149	4,090,000	24313	79	4.38584	141
3,650,000	20982	73	4.32185	152	4,100,000	24393	80	4.38727	143
3,660,000	21054	72	4.32333	148	4,110,000	24473	80	4.38869	142
3,670,000	21126	72	4.32482	149	4,120,000	24553	80	4.39010	141
3,680,000	21199	73	4.32632	150	4,130,000	24633	80	4.39152	142
3,690,000	21272	73	4.32781	149	4,140,000	24713	80	4.39293	141
3,700,000	21345	73	4.32930	149	4,150,000	24794	81	4.39435	142
3,710,000	21418	73	4.33078	148	4,160,000	24874	80	4.39575	140
3,720,000	21491	73	4.33226	148	4,170,000	24955	81	4.39716	141
3,730,000	21564	73	4.33373	147	4,180,000	25036	81	4.39856	140
3,740,000	21638	74	4.33522	149	4,190,000	25118	82	4.39999	143
3,750,000	21711	73	4.33668	146	4,200,000	25199	81	4.40138	139
3,760,000	21785	74	4.33816	148	4,210,000	25281	82	4.40279	141
3,770,000	21859	74	4.33963	147	4,220,000	25363	82	4.40420	141
3,780,000	21933	74	4.34110	147	4,230,000	25445	82	4.40560	140
3,790,000	22008	75	4.34258	148	4,240,000	25527	82	4.40700	140
3,800,000	22082	74	4.34404	146	4,250,000	25610	83	4.40841	141
3,810,000	22157	75	4.34551	147	4,260,000	25692	82	4.40980	139
3,820,000	22231	74	4.34696	145	4,270,000	25775	83	4.41120	140
3,830,000	22306	75	4.34842	146	4,280,000	25859	84	4.41261	141
3,840,000	22381	75	4.34988	146	4,290,000	25942	83	4.41400	139
3,850,000	22457	76	4.35135	147	4,300,000	26025	83	4.41539	139

Table 6. Convergence—Continued

Northing	Function XV	Diff.	Log XV	Diff.	Northing	Function XV	Diff.	Log XV	Diff.
4,300,000	26025	83	4.41539	139					
4,310,000	26109	84	4.41679	140	4,700,000	30117	94	4.47881	136
4,320,000	26193	84	4.41810	140	4,770,000	30212	95	4.48018	137
4,330,000	26277	84	4.41958	139	4,780,000	30307	95	4.48154	136
4,340,000	26362	85	4.42098	140	4,790,000	30403	96	4.48292	138
4,350,000	26446	84	4.42236	138	4,800,000	30498	95	4.48427	135
4,360,000	26531	85	4.42375	139	4,810,000	30594	96	4.48564	137
4,370,000	26616	85	4.42514	139	4,820,000	30691	97	4.48701	137
4,380,000	26702	86	4.42654	140	4,830,000	30787	96	4.48837	136
4,390,000	26787	85	4.42792	138	4,840,000	30884	97	4.48973	136
4,400,000	26873	86	4.42932	140	4,850,000	30981	97	4.49110	137
4,410,000	26959	86	4.43070	138	4,860,000	31079	98	4.49247	137
4,420,000	27045	86	4.43209	139	4,870,000	31177	98	4.49383	136
4,430,000	27131	86	4.43347	138	4,880,000	31275	98	4.49520	137
4,440,000	27218	87	4.43486	139	4,890,000	31373	98	4.49656	136
4,450,000	27305	87	4.43624	138	4,900,000	31472	99	4.49792	136
4,460,000	27392	87	4.43762	138	4,910,000	31570	98	4.49927	135
4,470,000	27479	87	4.43900	138	4,920,000	31670	100	4.50063	138
4,480,000	27567	88	4.44039	139	4,930,000	31769	99	4.50200	135
4,490,000	27654	87	4.44176	137	4,940,000	31869	100	4.50337	137
4,500,000	27742	88	4.44314	138	4,950,000	31969	100	4.50473	136
4,510,000	27831	89	4.44453	139	4,960,000	32070	101	4.50610	137
4,520,000	27919	88	4.44590	137	4,970,000	32170	100	4.50745	135
4,530,000	28008	89	4.44728	138	4,980,000	32272	102	4.50883	138
4,540,000	28097	89	4.44866	138	4,990,000	32373	101	4.51018	135
4,550,000	28186	89	4.45003	137	5,000,000	32475	102	4.51155	137
4,560,000	28275	89	4.45140	137	5,010,000	32577	102	4.51291	136
4,570,000	28365	90	4.45278	138	5,020,000	32679	102	4.51427	136
4,580,000	28455	90	4.45416	138	5,030,000	32782	103	4.51564	137
4,590,000	28545	90	4.45553	137	5,040,000	32885	103	4.51700	136
4,600,000	28635	90	4.45690	137	5,050,000	32988	103	4.51836	136
4,610,000	28726	91	4.45828	138	5,060,000	33092	104	4.51972	136
4,620,000	28817	91	4.45965	137	5,070,000	33196	104	4.52109	137
4,630,000	28908	91	4.46102	137	5,080,000	33300	104	4.52244	135
4,640,000	29000	92	4.46240	138	5,090,000	33405	105	4.52381	137
4,650,000	29091	91	4.46376	136	5,100,000	33510	105	4.52517	136
4,660,000	29183	92	4.46513	137	5,110,000	33615	105	4.52653	136
4,670,000	29276	93	4.46651	138	5,120,000	33721	106	4.52790	137
4,680,000	29368	92	4.46787	136	5,130,000	33827	106	4.52926	136
4,690,000	29461	93	4.46925	138	5,140,000	33933	106	4.53062	136
4,700,000	29554	93	4.47062	137	5,150,000	34040	107	4.53199	137
4,710,000	29647	93	4.47198	136	5,160,000	34147	107	4.53335	136
4,720,000	29740	93	4.47334	136	5,170,000	34254	107	4.53471	136
4,730,000	29834	94	4.47471	137	5,180,000	34362	108	4.53608	137
4,740,000	29928	94	4.47608	137	5,190,000	34470	108	4.53744	136
4,750,000	30023	95	4.47745	137	5,200,000	34579	109	4.53881	137

Table 6. Convergence—Continued

Northing	Function XV	Diff.	Log XV	Diff.	Northing	Function XV	Diff.	Log XV	Diff.
5,200,000	34570	109	4.53881	137					
5,210,000	34688	109	4.54018	137	5,660,000	40006	128	4.60213	140
5,220,000	34797	109	4.54154	136	5,670,000	40134	128	4.60351	138
5,230,000	34907	110	4.54291	137	5,680,000	40263	129	4.60491	140
5,240,000	35017	110	4.54428	137	5,690,000	40393	130	4.60631	140
5,250,000	35127	110	4.54564	136	5,700,000	40523	130	4.60770	139
5,260,000	35238	111	4.54701	137	5,710,000	40653	130	4.60909	139
5,270,000	35349	111	4.54838	137	5,720,000	40784	131	4.61049	140
5,280,000	35460	111	4.54974	136	5,730,000	40916	132	4.61189	140
5,290,000	35572	112	4.55111	137	5,740,000	41048	132	4.61329	140
5,300,000	35684	112	4.55247	136	5,750,000	41181	133	4.61470	141
5,310,000	35797	113	4.55385	138	5,760,000	41314	133	4.61610	140
5,320,000	35910	113	4.55522	137	5,770,000	41447	133	4.61749	139
5,330,000	36023	113	4.55658	136	5,780,000	41582	135	4.61891	142
5,340,000	36137	114	4.55795	137	5,790,000	41716	134	4.62030	139
5,350,000	36252	115	4.55933	138	5,800,000	41852	136	4.62172	142
5,360,000	36366	114	4.56070	137	5,810,000	41988	136	4.62313	141
5,370,000	36481	115	4.56207	137	5,820,000	42124	136	4.62453	140
5,380,000	36597	116	4.56345	138	5,830,000	42261	137	4.62594	141
5,390,000	36712	115	4.56481	136	5,840,000	42398	137	4.62735	141
5,400,000	36829	117	4.56619	138	5,850,000	42537	139	4.62877	142
5,410,000	36945	116	4.56756	137	5,860,000	42675	138	4.63017	140
5,420,000	37062	117	4.56893	137	5,870,000	42814	139	4.63159	142
5,430,000	37180	118	4.57031	138	5,880,000	42954	140	4.63300	141
5,440,000	37298	118	4.57169	138	5,890,000	43095	141	4.63443	143
5,450,000	37416	118	4.57306	137	5,900,000	43236	141	4.63585	142
5,460,000	37535	119	4.57444	138	5,910,000	43377	141	4.63726	141
5,470,000	37654	119	4.57581	137	5,920,000	43519	142	4.63868	142
5,480,000	37774	120	4.57719	138	5,930,000	43662	143	4.64010	142
5,490,000	37894	120	4.57857	138	5,940,000	43805	143	4.64152	142
5,500,000	38015	121	4.57996	139	5,950,000	43950	145	4.64296	144
5,510,000	38136	121	4.58134	138	5,960,000	44094	144	4.64438	142
5,520,000	38257	121	4.58271	137	5,970,000	44239	145	4.64581	143
5,530,000	38379	122	4.58409	138	5,980,000	44385	146	4.64724	143
5,540,000	38501	122	4.58547	138	5,990,000	44532	147	4.64867	143
5,550,000	38624	123	4.58686	139	6,000,000	44679	147	4.65010	143
5,560,000	38747	123	4.58824	138	6,010,000	44826	147	4.65153	143
5,570,000	38871	124	4.58963	139	6,020,000	44975	149	4.65297	144
5,580,000	38995	124	4.59101	138	6,030,000	45124	149	4.65441	144
5,590,000	39120	125	4.59240	139	6,040,000	45274	150	4.65585	144
5,600,000	39245	125	4.59378	138	6,050,000	45424	150	4.65729	144
5,610,000	39370	125	4.59517	139	6,060,000	45575	151	4.65873	144
5,620,000	39496	126	4.59655	138	6,070,000	45727	152	4.66017	144
5,630,000	39623	127	4.59795	140	6,080,000	45879	152	4.66161	144
5,640,000	39750	127	4.59934	139	6,090,000	46032	153	4.66306	145
5,650,000	39878	128	4.60073	139	6,100,000	46186	154	4.66451	145

Table 6. Convergence—Continued

Northing	Function XV	Diff.	Log XV	Diff.	Northing	Function XV	Diff.	Log XV	Diff.
6,100,000	46186	154	4.66451	145					
6,110,000	46340	154	4.66596	145	6,560,000	54091	192	4.73313	155
6,120,000	46495	155	4.66741	145	6,570,000	54284	193	4.73467	154
6,130,000	46651	156	4.66886	145	6,580,000	54478	194	4.73622	155
6,140,000	46807	156	4.67031	145	6,590,000	54673	195	4.73777	155
6,150,000	46965	158	4.67177	146	6,600,000	54869	196	4.73933	156
6,160,000	47123	158	4.67323	146	6,610,000	55066	197	4.74088	155
6,170,000	47281	158	4.67469	146	6,620,000	55264	198	4.74244	156
6,180,000	47441	160	4.67615	146	6,630,000	55463	199	4.74400	156
6,190,000	47601	160	4.67762	147	6,640,000	55663	200	4.74557	157
6,200,000	47761	160	4.67907	145	6,650,000	55864	201	4.74713	156
6,210,000	47923	162	4.68054	147	6,660,000	56067	203	4.74871	158
6,220,000	48078	155	4.68195	141	6,670,000	56270	203	4.75028	157
6,230,000	48241	163	4.68342	147	6,680,000	56475	205	4.75186	158
6,240,000	48405	164	4.68489	147	6,690,000	56681	206	4.75344	158
6,250,000	48570	165	4.68637	148	6,700,000	56888	207	4.75502	158
6,260,000	48735	165	4.68784	147	6,710,000	57096	208	4.75661	159
6,270,000	48901	166	4.68932	148	6,720,000	57305	209	4.75819	158
6,280,000	49068	167	4.69080	148	6,730,000	57515	210	4.75978	159
6,290,000	49236	168	4.69228	148	6,740,000	57727	212	4.76138	160
6,300,000	49404	168	4.69376	148	6,750,000	57940	213	4.76298	160
6,310,000	49574	170	4.69525	149	6,760,000	58153	213	4.76457	159
6,320,000	49744	170	4.69674	149	6,770,000	58369	216	4.76618	161
6,330,000	49915	171	4.69823	149	6,780,000	58585	216	4.76779	161
6,340,000	50087	172	4.69973	150	6,790,000	58803	218	4.76940	161
6,350,000	50259	172	4.70121	148	6,800,000	59021	218	4.77101	161
6,360,000	50433	174	4.70271	150	6,810,000	59241	220	4.77262	161
6,370,000	50607	174	4.70421	150	6,820,000	59463	222	4.77425	163
6,380,000	50782	175	4.70571	150	6,830,000	59685	222	4.77587	162
6,390,000	50958	176	4.70721	150	6,840,000	59909	224	4.77749	162
6,400,000	51135	177	4.70872	151	6,850,000	60134	225	4.77912	163
6,410,000	51313	178	4.71023	151	6,860,000	60361	227	4.78076	164
6,420,000	51492	179	4.71174	151	6,870,000	60589	228	4.78239	163
6,430,000	51671	179	4.71325	151	6,880,000	60818	229	4.78403	164
6,440,000	51852	181	4.71477	152	6,890,000	61049	231	4.78568	165
6,450,000	52033	181	4.71628	151	6,900,000	61281	232	4.78733	165
6,460,000	52215	182	4.71780	152	6,910,000	61514	233	4.78897	164
6,470,000	52399	184	4.71932	152	6,920,000	61749	235	4.79063	166
6,480,000	52583	184	4.72085	153	6,930,000	61985	236	4.79229	166
6,490,000	52768	185	4.72237	152	6,940,000	62222	237	4.79394	165
6,500,000	52954	186	4.72390	153	6,950,000	62461	239	4.79561	167
6,510,000	53141	187	4.72543	153	6,960,000	62702	241	4.79728	167
6,520,000	53329	188	4.72696	153	6,970,000	62943	241	4.79895	167
6,530,000	53518	189	4.72850	151	6,980,000	63187	244	4.80063	168
6,540,000	53708	190	4.73004	154	6,990,000	63432	245	4.80231	168
6,550,000	53899	191	4.73158	154	7,000,000	63678	246	4.80399	168

Table 6. Convergence—Continued

Northing	Function XV	Diff.	Log XV	Diff.	Northing	Function XV	Diff.	Log XV	Diff.
7,000,000	63678	246	4.80399	168					
7,010,000	63920	248	4.80568	169	7,460,000	76953	336	4.88623	190
7,020,000	64175	249	4.80737	169	7,470,000	77292	339	4.88813	190
7,030,000	64426	251	4.80906	169	7,480,000	77633	341	4.89005	192
7,040,000	64679	253	4.81076	170	7,490,000	77977	344	4.89197	192
7,050,000	64933	254	4.81247	171	7,500,000	78324	347	4.89389	192
7,060,000	65189	256	4.81417	170	7,510,000	78673	349	4.89583	194
7,070,000	65446	257	4.81588	171	7,520,000	79025	352	4.89776	193
7,080,000	65705	259	4.81760	172	7,530,000	79380	355	4.89971	195
7,090,000	65966	261	4.81932	172	7,540,000	79737	357	4.90160	195
7,100,000	66228	262	4.82104	172	7,550,000	80097	360	4.90362	196
7,110,000	66492	264	4.82277	173	7,560,000	80460	363	4.90558	196
7,120,000	66758	266	4.82450	173	7,570,000	80826	366	4.90755	197
7,130,000	67025	267	4.82624	174	7,580,000	81195	369	4.90953	198
7,140,000	67295	270	4.82798	174	7,590,000	81566	371	4.91151	198
7,150,000	67566	271	4.82973	175	7,600,000	81941	375	4.91350	199
7,160,000	67838	272	4.83147	174	7,610,000	82318	377	4.91549	199
7,170,000	68113	275	4.83323	176	7,620,000	82699	381	4.91750	201
7,180,000	68389	276	4.83499	176	7,630,000	83082	383	4.91951	201
7,190,000	68667	278	4.83675	176	7,640,000	83469	387	4.92153	202
7,200,000	68947	280	4.83852	177	7,650,000	83859	390	4.92355	202
7,210,000	69229	282	4.84029	177	7,660,000	84252	393	4.92558	203
7,220,000	69513	284	4.84207	178	7,670,000	84648	396	4.92762	204
7,230,000	69799	286	4.84385	178	7,680,000	85048	400	4.92966	204
7,240,000	70087	288	4.84564	179	7,690,000	85450	402	4.93171	205
7,250,000	70376	289	4.84742	178	7,700,000	85857	407	4.93378	207
7,260,000	70668	292	4.84922	180	7,710,000	86266	409	4.93584	206
7,270,000	70962	294	4.85103	181	7,720,000	86679	413	4.93791	207
7,280,000	71257	295	4.85283	180	7,730,000	87096	417	4.94000	209
7,290,000	71555	298	4.85464	181	7,740,000	87516	420	4.94209	209
7,300,000	71855	300	4.85646	182	7,750,000	87939	423	4.94418	209
7,310,000	72157	302	4.85828	182	7,760,000	88367	428	4.94629	211
7,320,000	72461	304	4.86010	182	7,770,000	88797	430	4.94840	211
7,330,000	72767	306	4.86193	183	7,780,000	89232	435	4.95052	212
7,340,000	73075	308	4.86377	184	7,790,000	89670	438	4.95265	213
7,350,000	73386	311	4.86561	184	7,800,000	90113	443	4.95479	214
7,360,000	73698	312	4.86746	185	7,810,000	90559	446	4.95693	214
7,370,000	74013	315	4.86931	185	7,820,000	91009	450	4.95908	215
7,380,000	74330	317	4.87116	185	7,830,000	91463	454	4.96125	217
7,390,000	74650	320	4.87303	187	7,840,000	91921	458	4.96341	216
7,400,000	74972	322	4.87490	187	7,850,000	92383	462	4.96559	218
7,410,000	75296	324	4.87677	187	7,860,000	92849	466	4.96778	219
7,420,000	75623	327	4.87865	188	7,870,000	93320	471	4.96997	219
7,430,000	75952	329	4.88054	189	7,880,000	93795	475	4.97218	221
7,440,000	76283	331	4.88243	189	7,890,000	94274	479	4.97439	221
7,450,000	76617	334	4.88433	190	7,900,000	94758	484	4.97662	223

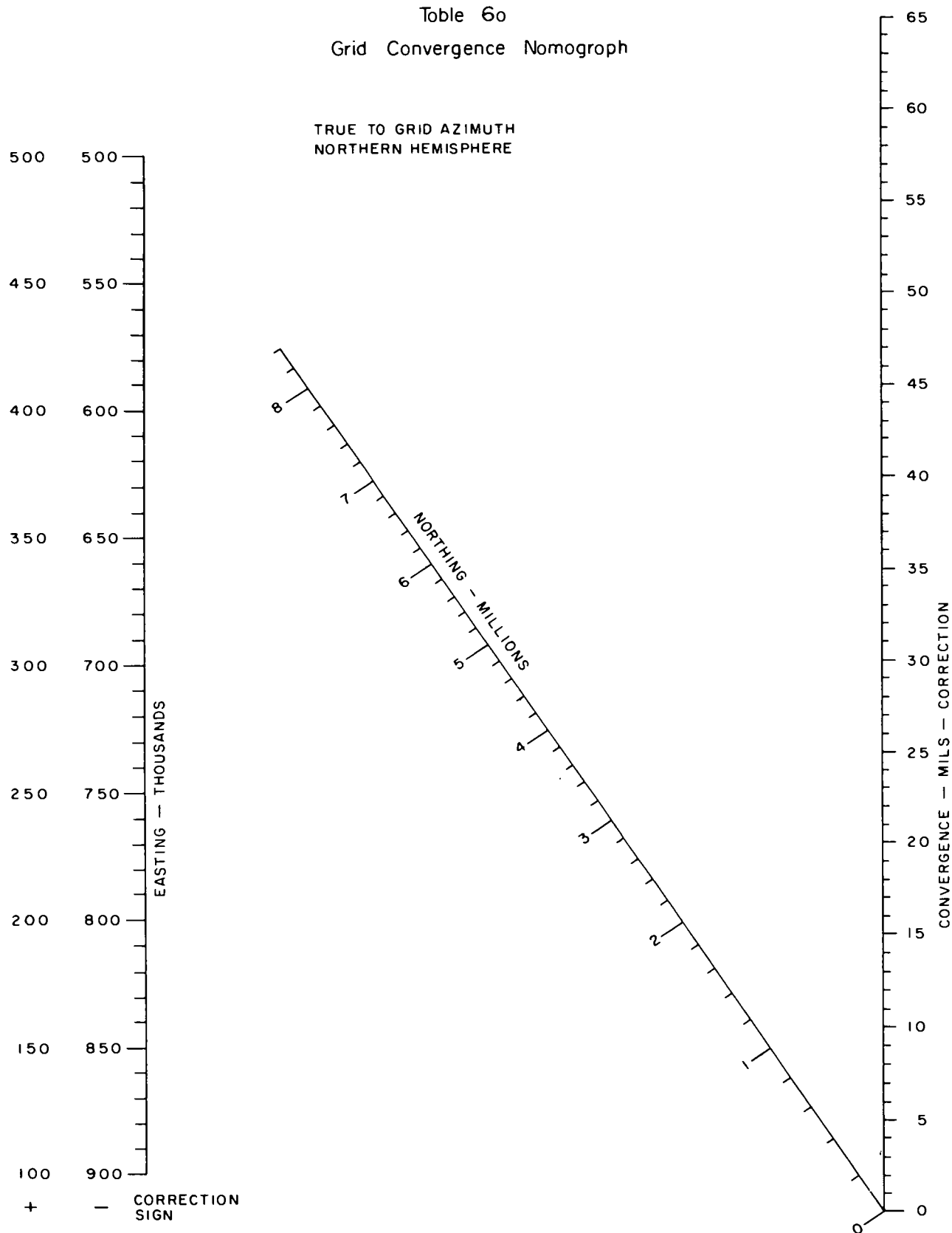
Table 6. Convergence—Continued

Northing	Function XV	Diff.	Log XV	Diff.	Northing	Function XV	Diff.	Log XV	Diff.
7,900,000	94758	484	4.97662	223					
7,910,000	95246	488	4.97885	223	8,360,000	123153	782	5.090445	2766
7,920,000	95738	492	4.98108	223	8,370,000	123943	790	5.093222	2777
7,930,000	96235	497	4.98333	225	8,380,000	124743	800	5.096016	2794
7,940,000	96737	502	4.98559	226	8,390,000	125553	810	5.098827	2811
7,950,000	97244	507	4.98786	227	8,400,000	126372	819	5.101651	2824
7,960,000	97755	511	4.99014	228	8,410,000	127202	830	5.104494	2843
7,970,000	98271	516	4.99243	229	8,420,000	128042	840	5.107352	2858
7,980,000	98792	521	4.99472	229	8,430,000	128893	851	5.110229	2877
7,990,000	99318	526	4.99703	231	8,440,000	129754	861	5.113121	2892
8,000,000	99850	532	4.99935	232	8,450,000	130626	872	5.116030	2909
8,010,000	100386	536	5.001673	2323	8,460,000	131510	884	5.118959	2929
8,020,000	100928	542	5.004012	2339	8,470,000	132404	894	5.121901	2942
8,030,000	101475	547	5.006359	2347	8,480,000	133310	906	5.124863	2962
8,040,000	102027	552	5.008715	2356	8,490,000	134228	918	5.127843	2980
8,050,000	102585	558	5.011084	2369	8,500,000	135158	930	5.130842	2999
8,060,000	103149	564	5.013465	2381	8,510,000	136101	943	5.133861	3019
8,070,000	103718	569	5.015854	2389	8,520,000	137055	954	5.136895	3034
8,080,000	104293	575	5.018255	2401	8,530,000	138023	968	5.139951	3056
8,090,000	104873	580	5.020664	2409	8,540,000	139003	980	5.143024	3073
8,100,000	105460	587	5.023088	2424	8,550,000	139997	994	5.146119	3095
8,110,000	106053	593	5.025523	2435	8,560,000	141005	1008	5.149235	3116
8,120,000	106651	598	5.027965	2442	8,570,000	142026	1021	5.152368	3133
8,130,000	107256	605	5.030422	2457	8,580,000	143062	1036	5.155524	3156
8,140,000	107868	612	5.032893	2471	8,590,000	144112	1050	5.158700	3176
8,150,000	108486	618	5.035374	2481	8,600,000	145176	1064	5.161895	3195
8,160,000	109110	624	5.037865	2491	8,610,000	146256	1080	5.165114	3219
8,170,000	109741	631	5.040369	2504	8,620,000	147351	1095	5.168353	3239
8,180,000	110379	638	5.042886	2517	8,630,000	148462	1111	5.171615	3262
8,190,000	111023	644	5.045413	2527	8,640,000	149590	1128	5.174903	3288
8,200,000	111675	652	5.047956	2543	8,650,000	150733	1143	5.178208	3305
8,210,000	112333	658	5.050507	2551	8,660,000	151894	1161	5.181541	3333
8,220,000	112999	666	5.053075	2568	8,670,000	153071	1177	5.184893	3352
8,230,000	113672	673	5.055654	2579	8,680,000	154267	1196	5.188273	3380
8,240,000	114353	681	5.058248	2594	8,690,000	155480	1213	5.191675	3402
8,250,000	115041	688	5.060853	2605	8,700,000	156712	1232	5.195102	3427
8,260,000	115737	696	5.063472	2619	8,710,000	157962	1250	5.198553	3451
8,270,000	116441	704	5.066106	2634	8,720,000	159232	1270	5.202030	3477
8,280,000	117153	712	5.068753	2647	8,730,000	160522	1290	5.205535	3505
8,290,000	117873	720	5.071414	2661	8,740,000	161831	1309	5.209062	3527
8,300,000	118601	728	5.074088	2674	8,750,000	163162	1331	5.212619	3557
8,310,000	119338	737	5.076779	2691	8,760,000	164514	1352	5.216203	3584
8,320,000	120083	745	5.079482	2703	8,770,000	165887	1373	5.219812	3609
8,330,000	120837	754	5.082200	2718	8,780,000	167283	1396	5.223452	3640
8,340,000	121600	763	5.084931	2734	8,790,000	168702	1419	5.227120	3668
8,350,000	122371	771	5.087679	2745	8,800,000	170144	1442	5.230817	3697

Table 6. Convergence—Continued

Northing	Function XV	Diff.	Log XV	Diff.	Northing	Function XV	Diff.	Log XV	Diff.
8,800,000	170144	1442	5.230817	3697					
8,810,000	171610	1400	5.234543	3726	8,860,000	179322	1500	5.253034	3883
8,820,000	173100	1400	5.238297	3754	8,870,000	180945	1023	5.257547	3913
8,830,000	174616	1516	5.242084	3787	8,880,000	182597	1652	5.261404	3947
8,840,000	176158	1542	5.245902	3818	8,890,000	184270	1082	5.265476	3982
8,850,000	177726	1568	5.249751	3849	8,900,000	185991	1712	5.269492	4016

Table 6o
Grid Convergence Nomograph



FOR SOUTHERN HEMISPHERE, SUBTRACT NORTHING FROM 10,000,000
USE OPPOSITE SIGN OF CORRECTION

Table 7. Second Term in Convergence Computation, UTM Coordinates

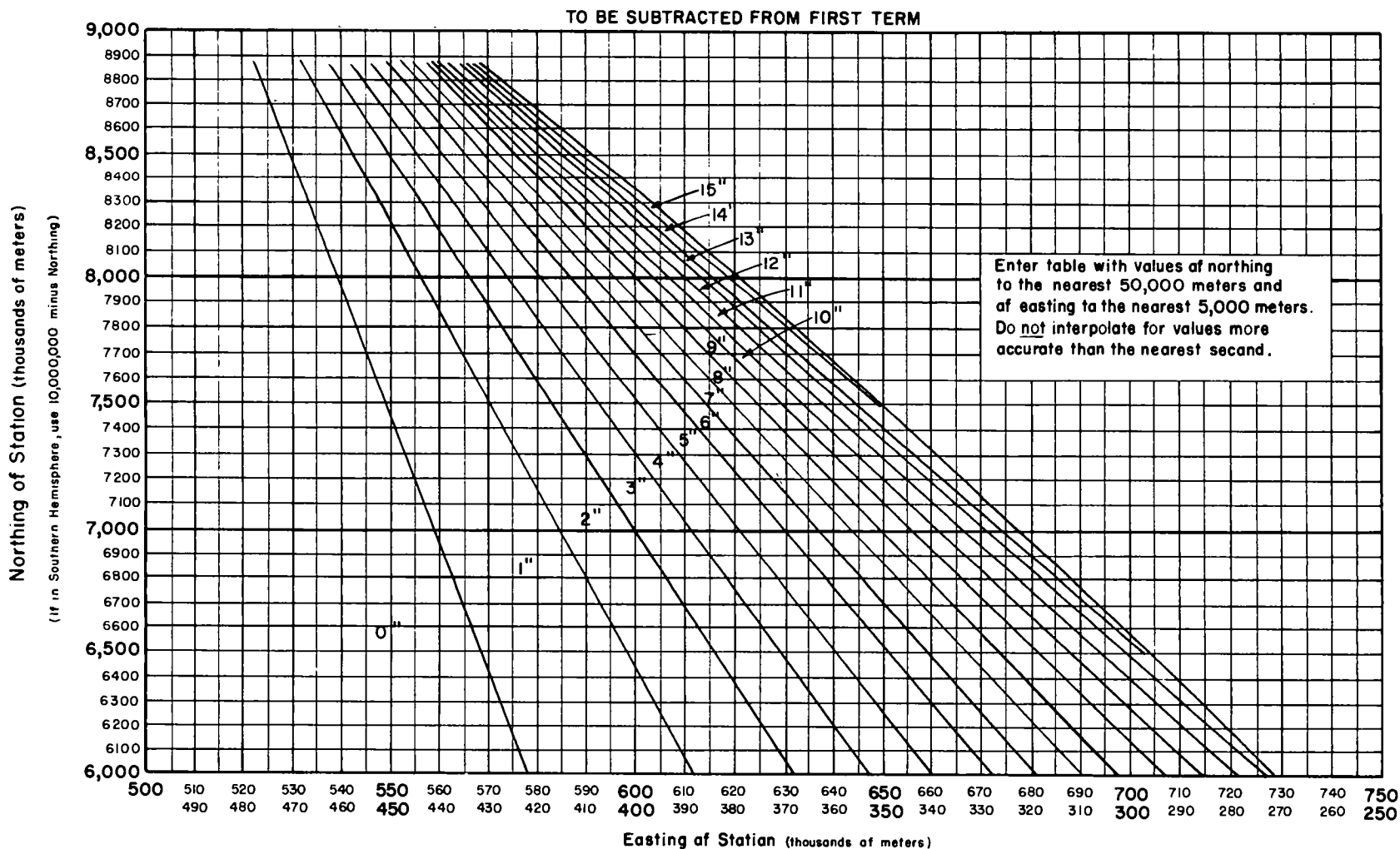
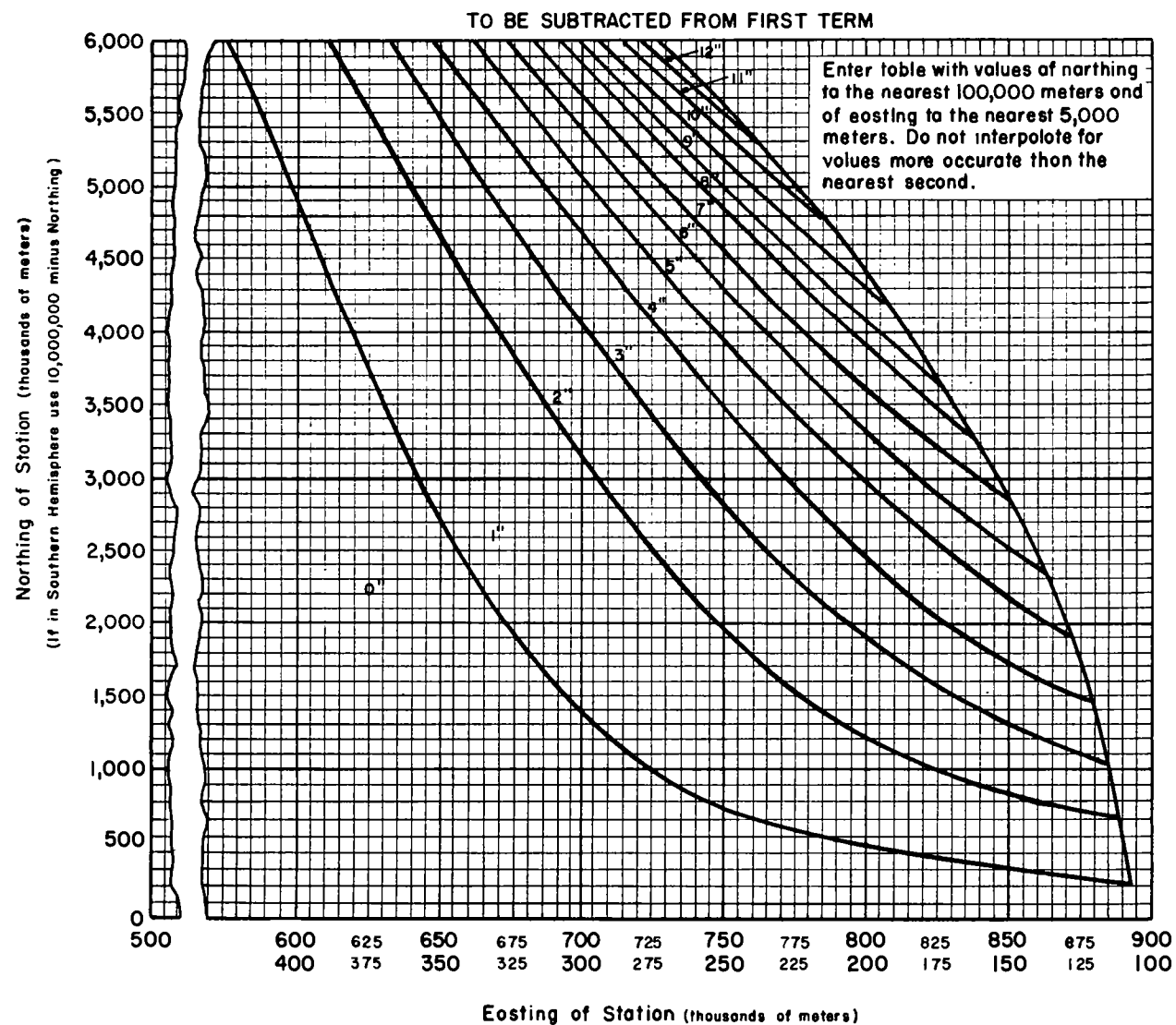


Table 7. Second Term in Convergence Computation, UTM Coordinates -- Continued



CONVERSION TABLE	
1"	0.00 m
2"	0.01 m
3"	0.01 m
4"	0.02 m
5"	0.02 m
6"	0.03 m
7"	0.03 m
8"	0.04 m
9"	0.04 m
10"	0.05 m
11"	0.05 m
12"	0.06 m
13"	0.06 m
14"	0.07 m
15"	0.07 m

Table 8a. Second Term in Convergenge Computotlon, Geographic Coordinotes (Degrees)

TO BE ADDED TO FIRST TERM

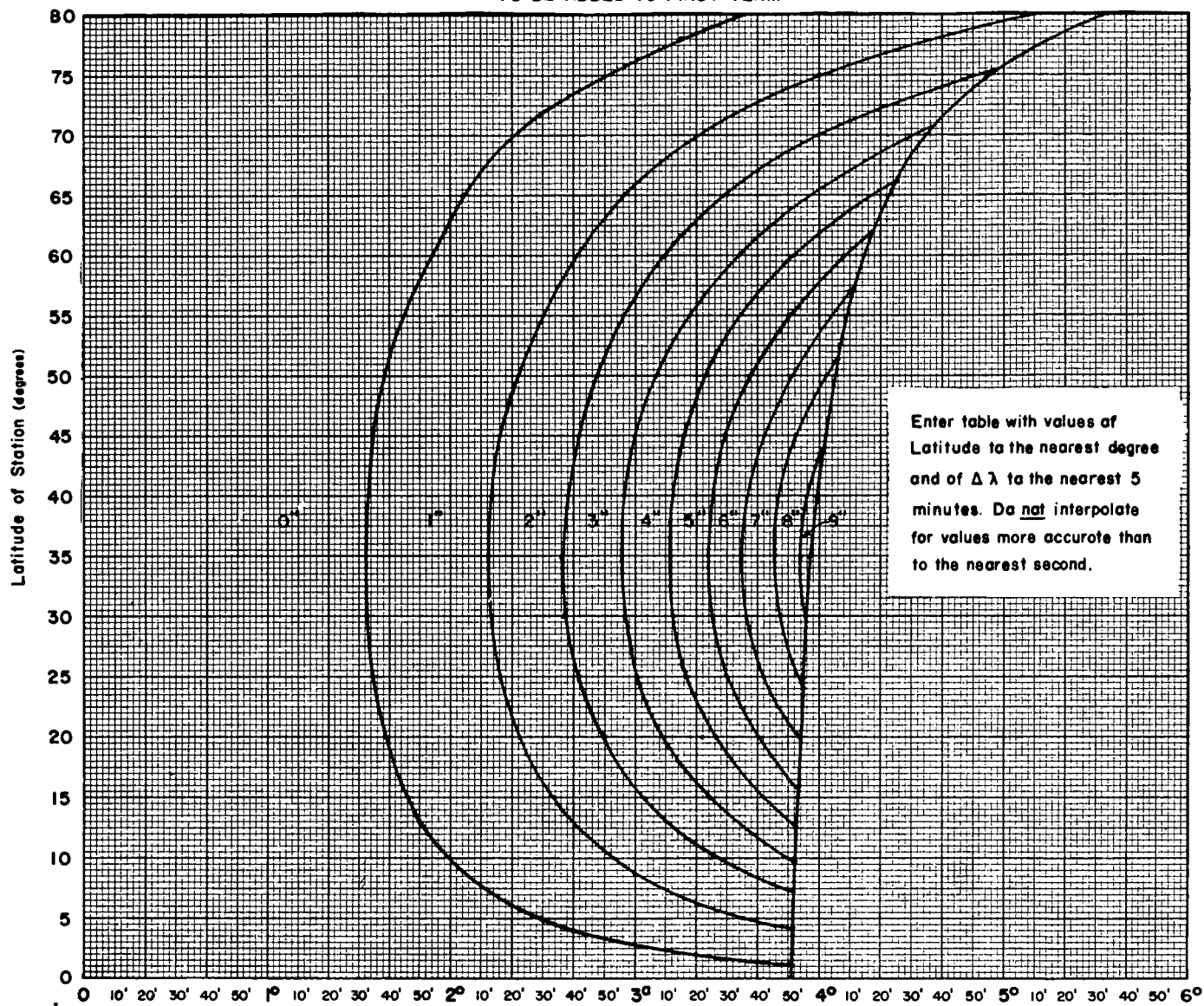

 $\Delta\lambda$ of station = longitude of station minus longitude of control meridian (degrees).

Table 8b. Second Term in Convergence Computation, Geographic Coordinates (Mils)
TO BE ADDED TO FIRST TERM

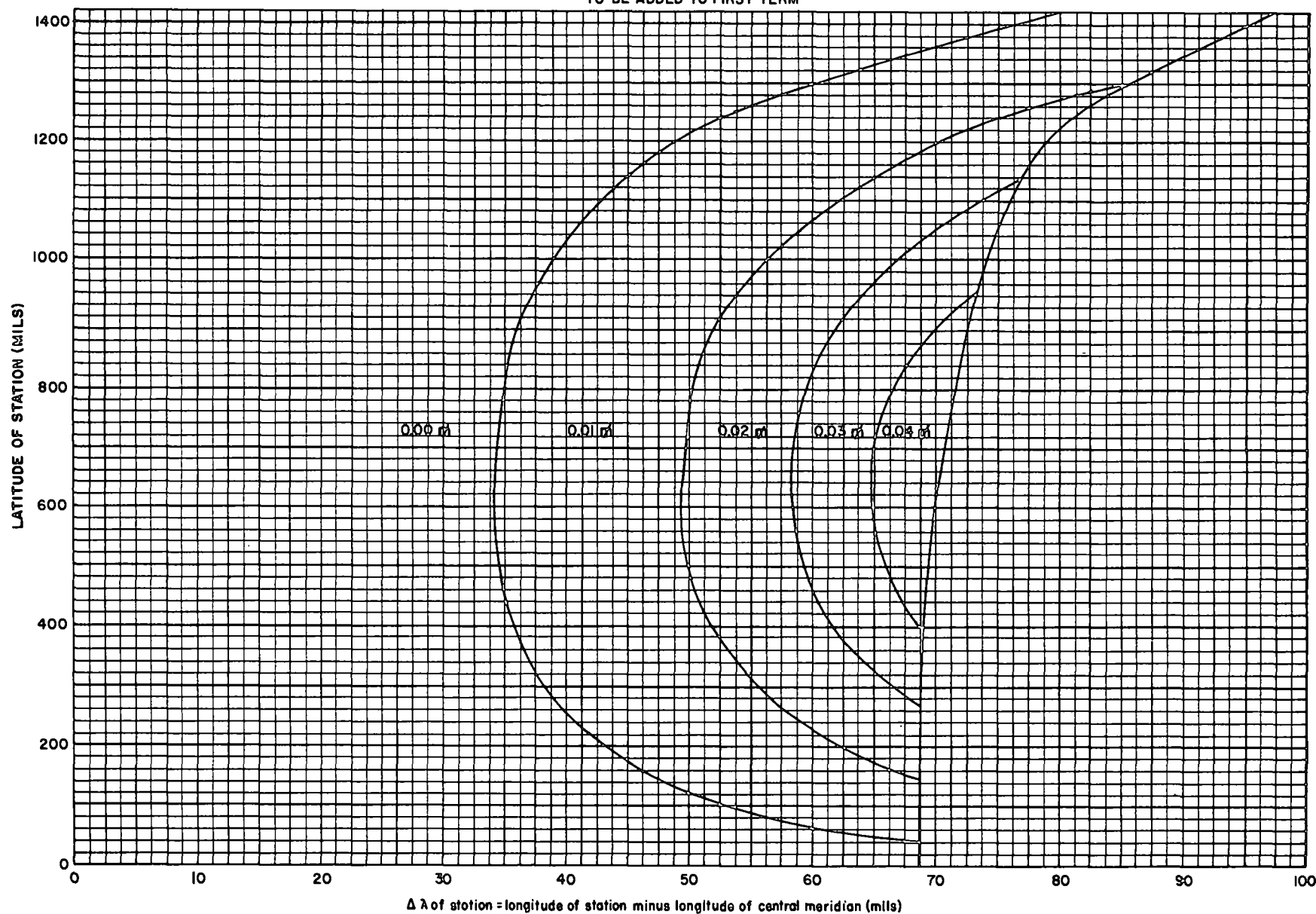


Table 9. Alphabetical Star List

Enter table with name of star to obtain the number for use in entering table 10a, 10b, or 11.

Star	Constellation	No.	Magnitude
Acamar, Theta (θ) Eridani.....	Eridanus.....	12	3.4
Achernar, Alpha (α) Eridani.....	Eridanus.....	9	0.6
Acrux, Alpha (α) Crucis.....	Crux.....	42	1.0
Adhara, Epsilon (ϵ) Canis Majoris.....	Canis Major.....	26	1.6
Aldebaran, Alpha (α) Tauri.....	Taurus.....	15	1.1
Alhena, Gamma (γ) Geminorum*.....	Gemini.....	24	1.9
Alioth, Epsilon (ϵ) Ursae Majoris.....	Ursa Major.....	45	1.7
Alkaid, (Benetnasch), Eta (η) Ursae Majoris.....	Ursa Major.....	48	1.9
Al Na'ir, Alpha (α) Gruia.....	Grus.....	71	2.2
Alnilam, Epsilon (ϵ) Orionis.....	Orion.....	20	1.7
Alnitak, Zeta (ζ) Orionis*.....	Orion.....	21	2.0
Alpha (α) Ceti, Menkar**.....	Cetus.....	13	2.8
Alpha (α) Persei, Mirfak.....	Perseus.....	14	1.9
Alpha (α) Tri Aust, Atria.....	Triangulum Australe.....	58	1.9
Alphard, Alpha (α) Hydrae.....	Hydra.....	35	2.2
Alphecca, Alpha (α) Coronae Bor.....	Corona Borealis.....	55	2.3
Alpheratz, Alpha (α) Andromedae.....	Andromeda.....	1	2.1
(Al Suhail), Suhail, Lambda (λ) Velorum.....	Vela (Argo).....	33	2.2
Altair, Alpha (α) Aquilae.....	Aquila.....	66	0.9
Ankaa, Alpha (α) Phoenix**.....	Phoenix.....	4	2.4
Antares, Alpha (α) Scorpii.....	Scorpius.....	57	1.2
Arcturus, Alpha (α) Bootis.....	Bootes.....	51	0.2
Atria, Alpha (α) Tri Aust.....	Triangulum Australe.....	58	1.9
Avior, Epsilon (ϵ) Carinae.....	Carina (Argo, Vela).....	32	1.7
Bellatrix, Gamma (γ) Orionis.....	Orion.....	18	1.7
Beta (β) Centauri, Hadar.....	Centaurus.....	49	0.9
Beta (β) Crucis, Mimosa*.....	Crux.....	44	1.5
Beta (β) Hydri***.....	Hydra.....	3	2.9
Betelgeuse, (Betelgeux), Alpha (α) Orionis.....	Orion.....	22	0.1
Canopus, Alpha (α) Carinae.....	Carina (Argo, Vela).....	23	-0.6
Capella, Alpha (α) Aurigae.....	Auriga.....	17	0.2
Caph, Beta (β) Cassiopeiae*.....	Cassiopeia.....	2	2.4
Castor, Alpha (α) Geminorum*.....	Gemini.....	28	1.6
Delta (δ) Canis Majoris, Wezen*.....	Canis Major.....	27	2.0
Deneb, Alpha (α) Cygni.....	Cygnus.....	68	1.3
Denebola, Beta (β) Leonis.....	Leo.....	39	2.2
Diphda, (Deneb Kaitos), Beta (β) Ceti.....	Cetus.....	6	2.2
Dschubba, Delta (δ) Scorpii**.....	Scorpius.....	56	2.5
Dubhe, Alpha (α) Ursae Majoris.....	Ursa Major.....	38	1.9
Elnath, (El Nath), Beta (β) Tauri.....	Taurus.....	19	1.8
Eltanin, (Eltamin), Gamma (γ) Draconis.....	Draco.....	62	2.4
Enif, Epsilon (ϵ) Pegasi.....	Pegasus.....	70	2.5
Epsilon (ϵ) Carinae, Avior.....	Carina (Argo, Vela).....	32	1.7
Fomalhaut, Alpha (α) Piscis Austrini.....	Piscis Austrinus.....	72	1.3
Gacrux, Gamma (γ) Crucis.....	Crux.....	43	1.6
Gamma (γ) Cassiopeiae*.....	Cassiopeia.....	7	1.6-2.8
Gamma (γ) Velorum, (Gamma Argus)*.....	Vela (Argo).....	31	1.9
Gamma (γ) Geminorum, Alhena*.....	Gemini.....	24	1.9
Gienah, Gamma (γ) Corvi**.....	Corvus.....	41	2.8
Hadar, Beta (β) Centauri.....	Centaurus.....	49	0.9
Hamal, Alpha (α) Arietis.....	Aries.....	11	2.2
Kaus Australis, Epsilon (ϵ) Sagittarii.....	Sagitta.....	63	1.9
Kochab, Beta (β) Ursae Minoris.....	Ursa Minor.....	54	2.2
Markab, Alpha (α) Pegasi.....	Pegasus.....	73	2.6
Menkar, Alpha (α) Ceti**.....	Cetus.....	13	2.8
Menkent, Theta (θ) Centauri.....	Centaurus.....	50	2.3
Merak, Beta (β) Ursae Majoris*.....	Ursa Major.....	37	2.4

Table 9. Alphabetical Star List—Continued

Star	Constellation	No.	Magnitude
Miaplacidus, Beta (β) Carinae.....	Carina (Argo).....	34	1.8
Mimosa, Beta (β) Crucis*.....	Crux.....	44	1.5
Mirfak, (Marfak), Alpha (α) Persei.....	Perseus.....	14	1.0
Mizar, Zeta (ζ) Ursae Majoris*.....	Ursa Major.....	46	2.4
Nunki, Sigma (σ) Sagittarii.....	Sagitta.....	65	2.1
(Octantis), Nu (ν) Octantis***.....	Octans.....	69	3.7
Peacock, Alpha (α) Pavonis.....	Pavo.....	67	2.1
Phecda, Gamma (γ) Ursae Majoris*.....	Ursa Major.....	40	2.5
Polaris, Alpha (α) Ursae Minoris***.....	Ursa Minor.....	10	2.1
Pollux, Beta (β) Geminorum.....	Gemini.....	30	1.2
Procyon, Alpha (α) Canis Minoris.....	Canis Minor.....	29	0.5
Rasalhague, Alpha (α) Ophiuchi.....	Ophiuchus.....	61	2.1
Regulus, Alpha (α) Leonis.....	Leo.....	36	1.3
Rigel, Beta (β) Orionis.....	Orion.....	16	0.3
Rigil Kentaurus, Alpha (α) Centauri.....	Centaurus.....	52	0.1
Ruchbah, Delta (δ) Cassiopeiae*.....	Cassiopeia.....	8	2.8
Sabik, Eta (η) Ophiuchi.....	Ophiuchus.....	59	2.6
Scaula, (Shaula), Lambda (λ) Scorpii.....	Scorpius.....	60	1.7
Schedar, (Schedir), Alpha (α) Cassiopeiae.....	Cassiopeia.....	5	2.3
Sirius, Alpha (α) Canis Majoris.....	Canis Major.....	25	-1.6
Spica, Alpha (α) Virginis.....	Virgo.....	47	1.2
Suhail, (Al Suhail), Lambda (λ) Velorum.....	Vela (Argo).....	33	2.2
Theta (θ) Centauri, Menkent.....	Centaurus.....	50	2.3
Vega, Alpha (α) Lyrae.....	Lyra.....	64	0.1
Wezen, Delta (δ) Canis Majoris*.....	Canis Major.....	27	2.0
Zeta (ζ) Orionis, Alnitak*.....	Orion.....	21	2.0
Zubenelgenubi, Alpha (α) Librae**.....	Libra.....	53	2.9

Note. Sirius (magnitude—1.6) is the brightest star listed, Octantis (magnitude 3.7) is the dimmest star listed. Brightness of other stars listed is indicated by their magnitude.

Spelled out names in parentheses are names sometimes used but not recommended.

* Indicates star not on identifier 2012D.

** Indicates star not on identifier 2012C.

*** Indicates star not on either identifier.

The constellation Argus has been replaced by its three modern divisions Carina, Puppis, and Vela.

Table 10a. Apparent Places of Stars, 1977 (Degrees)

STAR NO.	Right ascension Declination	(Hr Min) (° ')	Zero hours universal time (GMT) of first day of month												
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
			Seconds (time of RA; arc of DEC)												
1	RA DEC	0 7 28 57	12.3 61	11.9 57	11.7 52	11.8 48	12.2 46	13.1 47	14.1 52	15.1 59	15.7 67	16.0 73	15.9 78	15.6 80	15.2 78
2	RA DEC	0 7 59 1	57.6 43	56.7 39	56.1 32	56.2 23	56.9 17	58.2 15	59.8 18	61.2 25	62.1 35	62.5 45	62.3 54	61.6 60	60.6 60
3	RA DEC	0 24 -77 22	31.5 79	28.9 74	27.4 66	27.1 54	28.1 43	30.4 34	33.4 30	36.6 30	38.9 36	39.8 45	38.9 54	36.8 60	34.0 61
4	RA DEC	0 25 -42 25	8.9 63	8.3 62	8.0 57	8.0 49	8.4 40	9.2 31	10.4 25	11.5 23	12.3 25	12.6 30	12.5 37	12.1 43	11.5 46
5	RA DEC	0 39 56 24	13.0 60	12.1 57	11.5 51	11.3 43	11.9 36	13.1 34	14.5 36	15.5 42	16.9 51	17.5 60	17.5 69	17.0 75	16.2 77
6	RA DEC	0 42 -18 6	26.5 51	26.1 52	25.8 51	25.8 47	26.1 41	26.8 34	27.7 27	28.7 23	29.4 21	29.7 23	29.8 27	29.5 31	29.1 34
7	RA DEC	0 55 60 35	20.3 52	19.2 50	18.5 44	18.2 36	18.7 29	19.9 25	21.5 26	23.1 32	24.3 40	25.0 50	25.1 59	24.6 66	23.7 69
8	RA DEC	1 24 60 6	20.0 76	19.0 75	18.2 70	17.7 62	18.1 55	19.2 50	20.7 51	22.4 55	23.7 63	24.5 72	24.8 81	24.5 88	23.7 92
9	RA DEC	1 36 -57 20	51.8 89	50.8 89	50.0 84	49.4 75	49.5 65	50.2 55	51.4 47	52.9 43	54.1 45	54.9 51	55.0 60	54.6 69	53.7 73

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See Table 11. Apparent Places of Polaris, 1977

11	RA DEC	2 5 23 21	53.7 20	53.3 19	52.8 16	52.6 13	52.7 12	53.2 12	54.1 15	55.1 20	56.0 25	56.6 30	57.0 33	57.0 35	56.8 35
12	RA DEC	2 57 -40 23	24.4 62	23.7 65	23.1 64	22.5 59	22.3 51	22.6 41	23.3 33	24.3 26	25.4 24	26.2 27	26.7 35	26.7 43	26.4 50
13	RA DEC	3 1 3 59	5.9 57	5.5 55	5.1 54	4.7 54	4.6 55	4.9 59	5.7 64	6.6 69	7.4 72	8.1 74	8.6 74	8.8 72	8.7 69
14	RA DEC	3 22 49 46	42.9 57	42.3 59	41.6 57	40.9 53	40.7 47	41.1 42	42.1 40	43.4 41	44.7 45	45.8 50	46.6 56	47.0 62	46.8 67
15	RA DEC	4 34 16 27	37.8 46	37.6 45	37.1 44	36.6 43	36.3 43	36.4 43	36.9 45	37.7 48	38.6 51	39.5 52	40.2 53	40.7 52	40.9 51
16	RA DEC	5 13 -8 13	27.6 48	27.5 53	27.0 55	26.5 54	26.0 52	26.0 48	26.4 42	27.0 37	27.8 33	28.7 32	29.4 35	30.0 40	30.2 46
17	RA DEC	5 14 45 58	62.0 31	61.8 35	61.1 36	60.3 35	59.8 32	59.7 27	60.3 24	61.3 21	62.4 21	63.6 22	64.8 25	65.6 29	65.9 33
18	RA DEC	5 23 6 19	55.6 39	55.5 37	55.1 36	54.5 35	54.1 36	54.1 38	54.5 41	55.1 45	56.0 48	56.8 48	57.6 47	58.2 44	58.5 41
19	RA DEC	5 24 28 35	52.4 16	52.3 17	51.8 17	51.2 17	50.7 15	50.7 13	51.1 13	51.9 13	52.8 14	53.8 14	54.7 15	55.4 16	55.8 17

Table 10a. Apparent Places of Stars, 1977(Degrees) — Continued

STAR NO.	Right ascension Declination	(Hr Min) (° ')	Zero hours universal time (GMT) of first day of month												
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
			Seconds (time of RA; arc of DEC)												
20	RA DEC	5 35 -1 12	4.6 66	4.5 69	4.1 71	3.5 71	3.1 70	3.0 67	3.3 62	3.9 58	4.7 55	5.5 54	6.3 56	7.0 60	7.3 65
21	RA DEC	5 39 -1 57	37.7 23	37.6 27	37.2 29	36.7 29	36.2 27	36.1 24	36.4 20	37.0 15	37.8 12	38.6 12	39.5 14	40.1 18	40.4 23
22	RA DEC	5 53 7 24	57.5 5	57.4 2	57.1 1	56.5 1	56.1 2	55.9 3	56.2 6	56.8 9	57.6 11	58.4 12	59.3 10	60.0 7	60.4 4
23	RA DEC	6 23 -52 40	29.0 68	28.7 78	28.0 84	26.8 86	25.8 83	25.2 76	25.2 66	25.6 57	26.6 50	27.8 48	29.0 52	29.9 60	30.2 71
24	RA DEC	6 36 16 24	25.0 62	25.1 61	24.8 61	24.2 61	23.7 61	23.5 62	23.7 63	24.2 64	24.9 64	25.8 64	26.7 62	27.5 60	28.1 58
25	RA DEC	6 44 -16 41	9.8 14	9.9 20	9.5 24	8.9 26	8.4 24	8.1 20	8.2 14	8.6 8	9.3 3	10.1 2	11.0 5	11.7 12	12.2 19
26	RA DEC	6 57 -28 56	45.3 34	45.4 42	45.0 47	44.3 49	43.7 48	43.3 43	43.3 36	43.6 28	44.3 22	45.1 20	46.1 23	46.9 30	47.4 39
27	RA DEC	7 7 -26 21	29.3 30	29.4 39	29.1 44	28.4 46	27.8 45	27.4 40	27.4 34	27.7 26	28.4 20	29.2 18	30.1 21	31.0 28	31.5 37
28	RA DEC	7 33 31 56	10.0 11	10.3 13	10.1 15	9.6 17	8.9 18	8.6 17	8.6 15	9.0 13	9.7 10	10.6 7	11.6 5	12.6 3	13.4 3
29	RA DEC	7 38 5 16	7.8 54	8.1 50	7.9 48	7.4 48	6.9 49	6.6 51	6.6 53	6.9 55	7.4 57	8.2 56	9.1 53	10.0 49	10.6 44
30	RA DEC	7 43 28 4	56.6 45	56.9 46	56.8 48	56.2 50	55.6 50	55.3 50	55.3 49	55.6 47	56.2 45	57.1 42	58.1 39	59.1 37	59.8 36
31	RA DEC	8 8 -47 16	51.9 10	52.2 21	51.8 30	51.1 35	50.2 36	49.4 32	49.1 26	49.1 16	49.6 8	50.5 4	51.7 4	52.8 10	53.6 21
32	RA DEC	8 22 -59 26	5.8 9	6.1 20	5.6 30	4.6 36	3.4 38	2.3 35	1.6 29	1.5 19	2.0 10	3.0 4	4.5 4	5.9 10	6.9 20
33	RA DEC	9 7 -43 20	11.2 22	11.7 33	11.6 42	11.1 48	10.4 51	9.7 49	9.3 44	9.1 36	9.4 28	10.1 23	11.1 22	12.2 27	13.2 36
34	RA DEC	9 12 -69 37	61.7 17	62.4 29	62.0 40	60.8 48	59.1 53	57.3 53	56.0 48	55.3 39	55.5 29	56.7 22	58.6 19	60.7 22	62.4 31
35	RA DEC	9 26 -8 33	29.0 38	29.6 44	29.7 49	29.4 51	28.9 51	28.5 49	28.3 46	28.3 42	28.5 39	29.0 38	29.8 40	30.8 45	31.6 52
36	RA DEC	10 7 12 4	10.2 36	10.9 33	11.1 32	11.0 33	10.6 35	10.2 37	9.9 38	9.8 38	10.0 38	10.4 35	11.1 31	12.1 26	13.0 20
37	RA DEC	11 0 56 29	28.6 59	29.9 61	30.5 67	30.4 75	29.8 81	28.9 84	28.1 83	27.6 78	27.4 71	27.8 61	28.7 52	30.1 45	31.7 42

Table 10a. Apparent Places of Stars, 1977 (Degrees) — Continued

STAR NO.	Right ascension Decli- nation	(Hr Min) (° ')	Zero hours universal time (GMT) of first day of month												
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
			Seconds (time of RA; arc of DEC)												
38	RA DEC	11 2 61 51	20.0 68	21.5 71	22.2 77	22.1 85	21.3 92	20.2 95	19.3 94	18.6 89	18.4 80	18.8 70	19.8 61	21.4 54	23.2 51
39	RA DEC	11 47 14 41	53.9 52	54.8 47	55.3 46	55.5 48	55.3 51	55.0 54	54.7 56	54.4 56	54.2 55	54.3 52	54.8 47	55.6 40	56.6 34
40	RA DEC	11 52 53 48	37.8 60	39.2 60	39.9 65	40.2 72	39.8 80	39.0 85	38.3 86	37.6 82	37.3 76	37.3 67	37.9 56	39.1 48	40.5 43
41	RA DEC	12 14 -17 24	38.1 50	39.0 57	39.6 63	39.9 67	39.8 69	39.5 70	39.2 68	38.9 65	38.6 62	38.6 59	39.0 59	39.8 62	40.9 68
42	RA DEC	12 25 -62 58	20.4 3	22.1 10	23.1 19	23.6 30	23.4 39	22.7 45	21.7 47	20.6 44	19.8 38	19.6 29	20.3 22	21.7 19	23.5 21
43	RA DEC	12 29 -56 58	54.4 50	55.9 58	56.8 67	57.2 77	57.1 85	56.6 91	55.8 92	55.0 89	54.3 83	54.1 75	54.7 69	55.9 66	57.5 68
44	RA DEC	12 46 -59 33	23.5 32	25.1 39	26.1 48	26.7 58	26.7 66	26.2 73	25.4 75	24.4 73	23.6 67	23.4 59	23.9 52	25.1 48	26.7 50
45	RA DEC	12 53 56 4	0.7 45	2.2 43	3.2 46	3.7 53	3.6 62	3.0 69	2.2 71	1.3 70	0.6 64	0.3 55	0.6 45	1.5 35	2.9 27
46	RA DEC	13 22 55 2	59.3 25	60.7 22	61.8 24	62.5 31	62.5 39	62.0 47	61.2 51	60.4 51	59.6 46	59.2 38	59.3 27	60.0 16	61.3 8
47	RA DEC	13 23 -11 2	59.1 28	60.1 34	60.8 39	61.3 42	61.4 43	61.3 42	61.1 41	60.7 39	60.3 37	60.2 35	60.4 36	61.0 39	61.9 44
48	RA DEC	13 46 49 25	37.3 24	38.6 20	39.6 21	40.3 27	40.5 36	40.1 43	39.6 48	38.8 49	38.1 45	37.6 38	37.6 28	38.2 18	39.3 9
49	RA DEC	14 2 -60 15	11.9 29	13.6 32	15.0 39	16.1 47	16.5 56	16.4 63	15.8 68	14.9 68	13.9 65	13.2 58	13.3 50	14.2 45	15.7 44
50	RA DEC	14 5 -36 15	19.7 16	20.9 20	21.8 26	22.5 33	22.9 38	22.9 42	22.6 43	22.1 43	21.6 39	21.2 35	21.3 31	21.9 29	22.9 31
51	RA DEC	14 14 19 17	36.4 60	37.4 54	38.2 52	38.8 53	39.1 58	39.0 63	38.8 67	38.4 69	37.9 68	37.5 65	37.5 59	38.0 52	38.8 44
52	RA DEC	14 38 -60 44	2.6 3	4.4 5	5.8 10	7.0 18	7.6 26	7.6 33	7.1 38	6.2 40	5.0 37	4.2 31	4.1 24	4.8 18	6.3 15
53	RA DEC	14 49 -15 56	36.1 43	37.1 48	38.0 52	38.7 55	39.1 56	39.2 56	39.1 56	38.8 55	38.3 53	37.9 51	37.9 50	38.3 52	39.1 55
54	RA DEC	14 50 74 14	41.1 44	43.6 39	46.0 40	47.9 46	48.6 56	48.0 65	46.5 72	44.2 74	41.8 71	39.9 64	38.9 53	39.1 42	40.8 32
55	RA DEC	15 33 26 47	42.0 26	42.9 19	43.8 16	44.6 18	45.1 23	45.3 30	45.2 36	44.8 40	44.2 41	43.7 39	43.4 33	43.6 25	44.2 16

Table 10a. Apparent Places of Stars, 1977(Degrees) — Continued

STAR NO.	Right ascension Decli- nation	(Hr Min) (° ')	Zero hours universal time (GMT) of first day of month												
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
			Seconds (time of RA; arc of DEC)												
56	RA DEC	15 58 -22 33	57.8 17	58.8 20	59.7 23	60.6 26	61.2 27	61.6 28	61.7 28	61.4 28	60.9 27	60.4 26	60.1 24	60.3 24	61.0 25
57	RA DEC	16 27 -26 22	59.1 46	60.1 48	61.0 50	62.0 52	62.7 54	63.2 55	63.4 56	63.2 56	62.6 56	62.1 55	61.7 53	61.8 52	62.4 52
58	RA DEC	16 46 -68 58	11.2 60	13.3 55	15.4 55	17.7 58	19.5 64	20.6 71	20.9 79	20.2 85	18.7 87	17.1 85	16.0 79	15.9 72	17.0 65
59	RA DEC	17 9 -15 41	2.7 44	3.5 46	4.4 48	5.3 49	6.1 49	6.6 47	6.9 46	6.8 46	6.3 45	5.8 44	5.4 44	5.4 45	5.8 47
60	RA DEC	17 32 -37 5	1.8 8	2.7 7	3.7 6	4.8 7	5.8 9	6.5 11	6.9 13	6.9 15	6.3 17	5.7 17	5.1 14	5.0 12	5.4 9
61	RA DEC	17 33 12 34	51.0 38	51.7 32	52.5 28	53.4 28	54.1 31	54.7 37	55.0 43	54.9 48	54.4 51	53.9 51	53.4 49	53.2 44	53.5 37
62	RA DEC	17 56 51 29	2.3 33	3.0 23	3.9 17	5.2 16	6.2 21	7.0 31	7.2 40	6.9 49	6.0 55	5.0 56	4.0 52	3.5 44	3.5 33
63	RA DEC	18 22 -34 23	37.7 41	38.4 39	39.3 37	40.4 37	41.4 36	42.2 37	42.8 38	42.9 40	42.5 42	41.9 43	41.3 42	41.0 40	41.3 38
64	RA DEC	18 36 38 45	8.2 49	8.7 40	9.4 34	10.4 32	11.4 36	12.2 44	12.6 54	12.5 62	12.0 68	11.2 71	10.5 69	10.0 62	10.0 53
65	RA DEC	18 53 -26 19	49.4 28	50.0 27	50.7 26	51.7 25	52.6 24	53.5 22	54.1 22	54.3 23	54.0 24	53.5 25	52.9 25	52.6 24	52.7 23
66	RA DEC	19 49 8 48	38.8 33	39.1 28	39.7 25	40.4 24	41.3 27	42.1 32	42.8 39	43.1 44	42.9 48	42.5 50	41.9 50	41.5 47	41.5 42
67	RA DEC	20 23 -56 48	48.3 36	48.6 29	49.4 22	50.6 16	52.1 12	53.6 11	54.8 13	55.5 18	55.4 25	54.7 30	53.6 32	52.8 30	52.4 25
68	RA DEC	20 40 45 11	37.8 67	37.8 58	38.2 50	39.0 45	40.1 45	41.2 51	42.1 60	42.5 70	42.3 79	41.8 86	40.9 88	40.2 86	39.7 79
69	RA DEC	21 38 -77 29	53.2 43	52.4 34	53.1 24	55.3 14	58.2 8	61.6 5	64.7 7	66.9 13	67.3 22	66.1 30	63.6 34	60.9 34	58.8 28
70	RA DEC	21 43 9 46	2.9 17	2.9 13	3.1 10	3.6 9	4.4 11	5.3 16	6.2 23	6.8 29	6.9 34	6.8 37	6.3 38	5.9 36	5.6 33
71	RA DEC	22 6 -47 3	46.3 89	46.1 83	46.3 77	46.9 69	47.9 62	49.1 57	50.3 55	51.3 57	51.6 61	51.4 67	50.8 72	50.1 74	49.6 73
72	RA DEC	22 56 -29 44	22.5 45	22.3 43	22.3 39	22.7 33	23.3 26	24.3 20	25.3 15	26.2 14	26.7 15	26.7 19	26.4 23	25.9 27	25.4 28
73	RA DEC	23 3 15 4	36.9 62	36.6 58	36.6 54	36.9 52	37.5 53	38.4 57	39.3 63	40.1 70	40.6 76	40.6 80	40.4 82	40.0 82	39.6 79

Table 10b. Apparent Places of Stars, 1977 (Mils of Declination)

STAR NO.	Right ascension Decli- nation	(Hr Min) (Mils)	Zero hours universal time (GMT) of first day of month												
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
			Seconds of time of RA; mils of DEC												
1	RA DEC	0 7 514	12.3 0.97	11.9 0.95	11.7 0.92	11.8 0.90	12.2 0.89	13.1 0.90	14.1 0.92	15.1 0.96	15.7 1.00	16.0 1.03	15.9 1.05	15.6 1.06	15.2 1.05
2	RA DEC	0 7 1049	57.6 0.40	56.7 0.38	56.1 0.34	56.2 0.30	56.9 0.27	58.2 0.26	59.8 0.28	61.2 0.31	62.1 0.36	62.5 0.41	62.3 0.45	61.6 0.48	60.6 0.48
3	RA DEC	0 24 -1375	31.5 0.80	28.9 0.77	27.4 0.73	27.1 0.68	28.1 0.62	30.4 0.58	33.4 0.55	36.6 0.56	38.9 0.59	39.8 0.63	38.9 0.67	36.8 0.70	34.0 0.71
4	RA DEC	0 25 -754	8.9 0.39	8.3 0.38	8.0 0.35	8.0 0.32	8.4 0.27	9.2 0.23	10.4 0.20	11.5 0.19	12.3 0.20	12.6 0.22	12.5 0.26	12.1 0.29	11.5 0.30
5	RA DEC	0 39 1002	13.0 0.96	12.1 0.95	11.5 0.92	11.3 0.88	11.9 0.85	13.1 0.83	14.5 0.84	15.9 0.87	16.9 0.92	17.5 0.97	17.5 1.01	17.0 1.04	16.2 1.05
6	RA DEC	0 42 -321	26.5 1.03	26.1 1.04	25.8 1.03	25.8 1.01	26.1 0.98	26.8 0.95	27.7 0.91	28.7 0.89	29.4 0.88	29.7 0.89	29.8 0.91	29.5 0.93	29.1 0.95
7	RA DEC	0 55 1077	20.3 0.29	19.2 0.28	18.5 0.25	18.2 0.21	18.7 0.18	19.9 0.16	21.5 0.17	23.1 0.19	24.3 0.24	25.0 0.28	25.1 0.33	24.6 0.36	23.7 0.38
8	RA DEC	1 24 1068	20.0 0.82	19.0 0.81	18.2 0.79	17.7 0.75	18.1 0.71	19.2 0.69	20.7 0.69	22.4 0.72	23.7 0.75	24.5 0.80	24.8 0.85	24.5 0.88	23.7 0.90
9	RA DEC	1 36 -1019	51.8 0.70	50.8 0.70	50.0 0.68	49.4 0.63	49.5 0.58	50.2 0.53	51.4 0.49	52.9 0.47	54.1 0.48	54.9 0.51	55.0 0.56	54.6 0.60	53.7 0.62

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See Table 11. Apparent Places of Polaris, 1977

11	RA DEC	2 5 415	53.7 0.21	53.3 0.20	52.8 0.19	52.6 0.18	52.7 0.17	53.2 0.17	54.1 0.19	55.1 0.21	56.0 0.24	56.6 0.26	57.0 0.28	57.0 0.28	56.8 0.28
12	RA DEC	2 57 -718	24.4 0.23	23.7 0.25	23.1 0.24	22.5 0.22	22.3 0.18	22.6 0.13	23.3 0.09	24.3 0.05	25.4 0.05	26.2 0.06	26.7 0.10	26.7 0.14	26.4 0.17
13	RA DEC	3 1 71	5.9 0.10	5.5 0.09	5.1 0.08	4.7 0.08	4.6 0.09	4.9 0.10	5.7 0.13	6.6 0.15	7.4 0.17	8.1 0.18	8.6 0.18	8.8 0.17	8.7 0.16
14	RA DEC	3 22 884	42.9 1.02	42.3 1.03	41.6 1.02	40.9 1.00	40.7 0.97	41.1 0.95	42.1 0.94	43.4 0.94	44.7 0.96	45.8 0.99	46.6 1.02	47.0 1.05	46.8 1.07
15	RA DEC	4 34 292	37.8 0.67	37.6 0.67	37.1 0.66	36.6 0.66	36.3 0.66	36.4 0.66	36.9 0.67	37.7 0.68	38.6 0.70	39.5 0.70	40.2 0.70	40.7 0.70	40.9 0.70
16	RA DEC	5 13 -146	27.6 0.31	27.5 0.33	27.0 0.34	26.5 0.34	26.0 0.33	26.0 0.31	26.4 0.28	27.0 0.26	27.8 0.24	28.7 0.23	29.4 0.25	30.0 0.27	30.2 0.30
17	RA DEC	5 14 817	62.0 0.34	61.8 0.36	61.1 0.36	60.3 0.36	59.8 0.34	59.7 0.32	60.3 0.30	61.3 0.29	62.4 0.29	63.6 0.29	64.8 0.31	65.6 0.33	65.9 0.35
18	RA DEC	5 23 112	55.6 0.49	55.5 0.48	55.1 0.47	54.5 0.47	54.1 0.48	54.1 0.49	54.5 0.50	55.1 0.52	56.0 0.53	56.8 0.53	57.6 0.53	58.2 0.51	58.5 0.50
19	RA DEC	5 24 508	52.4 0.23	52.3 0.23	51.8 0.23	51.2 0.23	50.7 0.22	50.7 0.21	51.1 0.21	51.9 0.21	52.8 0.21	53.8 0.22	54.7 0.22	55.4 0.23	55.8 0.23

Table 10b. Apparent Places of Stars, 1977(Mils of Declination) — Continued

STAR NO.	Right ascension Deci- nation	(Hr Min) (Mils)	Zero hours universal time (GMT) of first day of month											
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
			Seconds of time of RA; mils of DEC											
20	RA DEC	5 35 -21	4.6 0.66	4.5 0.68	4.1 0.68	3.5 0.69	3.1 0.68	3.0 0.66	3.3 0.64	3.9 0.62	4.7 0.60	5.5 0.60	6.3 0.61	7.0 0.63
21	RA DEC	5 39 -34	37.7 0.78	37.6 0.80	37.2 0.81	36.7 0.81	36.2 0.80	36.1 0.79	36.4 0.77	37.0 0.74	37.8 0.73	38.6 0.72	39.5 0.74	40.1 0.76
22	RA DEC	5 53 131	57.5 0.58	57.4 0.57	57.1 0.56	56.5 0.56	56.1 0.56	55.9 0.57	56.2 0.59	56.8 0.60	57.6 0.61	58.4 0.61	59.3 0.61	60.0 0.59
23	RA DEC	6 23 -936	29.0 0.63	28.7 0.68	28.0 0.71	26.8 0.72	25.8 0.71	25.2 0.67	25.2 0.62	25.6 0.58	26.6 0.54	27.8 0.53	29.0 0.55	29.9 0.59
24	RA DEC	6 36 291	25.0 0.86	25.1 0.86	24.8 0.86	24.2 0.86	23.7 0.86	23.5 0.86	23.7 0.86	24.2 0.87	24.9 0.87	25.8 0.87	26.7 0.86	27.5 0.85
25	RA DEC	6 44 -296	9.8 0.66	9.9 0.69	9.5 0.71	8.9 0.72	8.4 0.71	8.1 0.69	8.2 0.66	8.6 0.63	9.3 0.61	10.1 0.60	11.0 0.62	11.7 0.65
26	RA DEC	6 57 -514	45.3 0.54	45.4 0.58	45.0 0.60	44.3 0.61	43.7 0.61	43.3 0.58	43.3 0.55	43.6 0.51	44.3 0.48	45.1 0.47	46.1 0.48	46.9 0.52
27	RA DEC	7 7 -468	29.3 0.59	29.4 0.64	29.1 0.66	28.4 0.67	27.8 0.67	27.4 0.64	27.4 0.61	27.7 0.57	28.4 0.55	29.2 0.54	30.1 0.55	31.0 0.58
28	RA DEC	7 33 567	10.0 0.76	10.3 0.77	10.1 0.78	9.6 0.79	8.9 0.79	8.6 0.79	8.6 0.78	9.0 0.77	9.7 0.75	10.6 0.74	11.6 0.73	12.6 0.72
29	RA DEC	7 38 93	7.8 0.90	8.1 0.88	7.9 0.87	7.4 0.87	6.9 0.87	6.6 0.88	6.6 0.89	6.9 0.90	7.4 0.91	8.2 0.91	9.1 0.89	10.0 0.87
30	RA DEC	7 43 499	56.6 0.19	56.9 0.19	56.8 0.20	56.2 0.21	55.6 0.21	55.3 0.21	55.3 0.20	55.6 0.19	56.2 0.18	57.1 0.17	58.1 0.16	59.1 0.15
31	RA DEC	8 8 -840	51.9 0.35	52.2 0.40	51.8 0.44	51.1 0.47	50.2 0.47	49.4 0.46	49.1 0.42	49.1 0.38	49.6 0.34	50.5 0.31	51.7 0.32	52.8 0.35
32	RA DEC	8 22 -1056	5.8 0.63	6.1 0.69	5.6 0.74	4.6 0.77	3.4 0.78	2.3 0.77	1.6 0.73	1.5 0.69	2.0 0.64	3.0 0.61	4.5 0.61	5.9 0.64
33	RA DEC	9 7 -770	11.2 0.48	11.7 0.53	11.6 0.58	11.1 0.61	10.4 0.62	9.7 0.61	9.3 0.59	9.1 0.55	9.4 0.51	10.1 0.48	11.1 0.48	12.2 0.50
34	RA DEC	9 12 -1237	61.7 0.72	62.4 0.77	62.0 0.83	60.8 0.87	59.1 0.89	57.3 0.89	56.0 0.87	55.3 0.82	55.5 0.77	56.7 0.74	58.6 0.72	60.7 0.74
35	RA DEC	9 26 -152	29.0 0.19	29.6 0.22	29.7 0.24	29.4 0.25	28.9 0.25	28.5 0.24	28.3 0.23	28.3 0.21	28.5 0.19	29.0 0.19	29.8 0.20	30.8 0.22
36	RA DEC	10 7 214	10.2 0.70	10.9 0.68	11.1 0.68	11.0 0.68	10.6 0.69	10.2 0.70	9.9 0.71	9.8 0.71	10.0 0.71	10.4 0.69	11.1 0.67	12.1 0.64
37	RA DEC	11 0 1004	28.6 0.44	29.9 0.45	30.5 0.48	30.4 0.52	29.8 0.55	28.9 0.56	28.1 0.56	27.6 0.54	27.4 0.50	27.8 0.45	28.7 0.41	30.1 0.37

Table 10b. Apparent Places of Stars, 1977 (Mils of Declination) — Continued

STAR NO.	Right ascension (Hr Min)	Declination (Mils)	Zero hours universal time (GMT) of first day of month											
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
			Seconds of time of RA; mils of DEC											
38	RA DEC	11 2 1099	20.0 0.89	21.5 0.91	22.2 0.94	22.1 0.98	21.3 1.01	20.2 1.03	19.3 1.02	18.6 0.99	18.4 0.95	18.8 0.90	19.8 0.86	21.4 0.82
39	RA DEC	11 47 261	53.9 0.29	54.8 0.27	55.3 0.26	55.5 0.27	55.3 0.29	55.0 0.30	54.7 0.31	54.4 0.31	54.2 0.31	54.3 0.29	54.8 0.27	55.6 0.24
40	RA DEC	11 52 956	37.8 0.74	39.2 0.74	39.9 0.76	40.2 0.80	39.8 0.84	39.0 0.86	38.3 0.87	37.6 0.85	37.3 0.82	37.3 0.77	37.9 0.72	39.1 0.68
41	RA DEC	12 14 -309	38.1 0.58	39.0 0.61	39.6 0.64	39.9 0.67	39.8 0.68	39.5 0.68	39.2 0.67	38.9 0.66	38.6 0.64	38.6 0.63	39.0 0.63	39.8 0.64
42	RA DEC	12 25 -1119	20.4 0.42	22.1 0.46	23.1 0.50	23.6 0.56	23.4 0.60	22.7 0.63	21.7 0.64	20.6 0.63	19.8 0.59	19.6 0.55	20.3 0.52	21.7 0.50
43	RA DEC	12 29 -1012	54.4 0.99	55.9 1.03	56.8 1.07	57.2 1.12	57.1 1.16	56.6 1.19	55.8 1.20	55.0 1.18	54.3 1.15	54.1 1.11	54.7 1.08	55.9 1.07
44	RA DEC	12 46 -1058	23.5 0.83	25.1 0.86	26.1 0.90	26.7 0.95	26.7 0.99	26.2 1.03	25.4 1.04	24.4 1.03	23.6 1.00	23.4 0.96	23.9 0.92	25.1 0.90
45	RA DEC	12 53 996	0.7 0.96	2.2 0.95	3.2 0.97	3.7 1.00	3.6 1.05	3.0 1.08	2.2 1.09	1.3 1.09	0.6 1.06	0.3 1.01	0.6 0.96	1.5 0.91
46	RA DEC	13 22 978	59.3 0.49	60.7 0.48	61.8 0.49	62.5 0.52	62.5 0.57	62.0 0.60	61.2 0.62	60.4 0.62	59.6 0.60	59.2 0.56	59.3 0.50	60.0 0.45
47	RA DEC	13 23 -196	59.1 0.29	60.1 0.32	60.8 0.34	61.3 0.35	61.4 0.36	61.3 0.36	61.1 0.35	60.7 0.34	60.3 0.33	60.2 0.32	60.4 0.33	61.0 0.34
48	RA DEC	13 46 878	37.3 0.64	38.6 0.62	39.6 0.62	40.3 0.65	40.5 0.69	40.1 0.73	39.6 0.76	38.8 0.76	38.1 0.74	37.6 0.71	37.6 0.66	38.2 0.61
49	RA DEC	14 2 -1071	11.9 0.25	13.6 0.27	15.0 0.30	16.1 0.35	16.5 0.39	16.4 0.42	15.8 0.45	14.9 0.45	13.9 0.43	13.2 0.40	13.3 0.36	14.2 0.33
50	RA DEC	14 5 -644	19.7 0.52	20.9 0.55	21.8 0.57	22.5 0.61	22.9 0.63	22.9 0.65	22.6 0.66	22.1 0.65	21.6 0.64	21.2 0.62	21.3 0.60	21.9 0.59
51	RA DEC	14 14 343	36.4 0.11	37.4 0.08	38.2 0.07	38.8 0.08	39.1 0.10	39.0 0.12	38.8 0.14	38.4 0.15	37.9 0.15	37.5 0.14	37.5 0.11	38.0 0.07
52	RA DEC	14 38 -1079	2.6 0.72	4.4 0.73	5.8 0.75	7.0 0.79	7.6 0.83	7.6 0.87	7.1 0.89	6.2 0.90	5.0 0.89	4.2 0.86	4.1 0.82	4.8 0.79
53	RA DEC	14 49 -283	36.1 0.47	37.1 0.49	38.0 0.51	38.7 0.53	39.1 0.54	39.2 0.54	39.1 0.53	38.8 0.53	38.3 0.52	37.9 0.51	37.9 0.51	38.3 0.52
54	RA DEC	14 50 1319	41.1 0.92	43.6 0.90	46.0 0.90	47.9 0.93	48.6 0.98	48.0 1.03	46.5 1.06	44.2 1.07	41.8 1.06	39.9 1.02	38.9 0.97	39.1 0.91
55	RA DEC	15 33 476	42.0 0.27	42.9 0.24	43.8 0.23	44.6 0.24	45.1 0.26	45.3 0.30	45.2 0.33	44.8 0.35	44.2 0.35	43.7 0.34	43.4 0.31	43.6 0.27

Table 10b. Apparent Places of Stars, 1977 (Mils of Declination) — Continued

STAR NO.	Right ascension Decli- nation	(Hr Min) (Mils)	Zero hours universal time (GMT) of first day of month												
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
			Seconds of time of RA; mils of DEC												
56	RA DEC	15 58 -400	57.8 0.97	58.8 0.99	59.7 1.00	60.6 1.02	61.2 1.02	61.6 1.03	61.7 1.03	61.4 1.03	60.9 1.02	60.4 1.02	60.1 1.01	60.3 1.01	61.0 1.01
57	RA DEC	16 27 -468	59.1 0.97	60.1 0.98	61.0 0.99	62.0 1.00	62.7 1.01	63.2 1.01	63.4 1.02	63.2 1.02	62.6 1.02	62.1 1.01	61.7 1.00	61.8 1.00	62.4 1.00
58	RA DEC	16 46 -1226	11.2 0.37	13.3 0.35	15.4 0.35	17.7 0.36	19.5 0.39	20.6 0.43	20.9 0.46	20.2 0.49	18.7 0.50	17.1 0.50	16.0 0.47	15.9 0.43	17.0 0.39
59	RA DEC	17 9 -279	2.7 0.03	3.5 0.04	4.4 0.05	5.3 0.06	6.1 0.06	6.6 0.05	6.9 0.04	6.8 0.04	6.3 0.04	5.8 0.03	5.4 0.03	5.4 0.04	5.8 0.04
60	RA DEC	17 32 -659	1.8 0.30	2.7 0.29	3.7 0.29	4.8 0.30	5.8 0.30	6.5 0.31	6.9 0.32	6.9 0.34	6.3 0.34	5.7 0.34	5.1 0.33	5.0 0.32	5.4 0.30
61	RA DEC	17 33 223	51.0 0.60	51.7 0.56	52.5 0.55	53.4 0.55	54.1 0.56	54.7 0.59	55.0 0.62	54.9 0.64	54.4 0.66	53.9 0.66	53.4 0.65	53.2 0.62	53.5 0.59
62	RA DEC	17 56 915	2.3 0.42	3.0 0.37	3.9 0.34	5.2 0.34	6.2 0.36	7.0 0.41	7.2 0.46	6.9 0.50	6.0 0.53	5.0 0.53	4.0 0.52	3.5 0.48	3.5 0.42
63	RA DEC	18 22 -611	37.7 0.46	38.4 0.45	39.3 0.44	40.4 0.44	41.4 0.44	42.2 0.44	42.8 0.45	42.9 0.46	42.5 0.47	41.9 0.47	41.3 0.47	41.0 0.46	41.3 0.45
64	RA DEC	18 36 689	8.2 0.13	8.7 0.09	9.4 0.06	10.4 0.05	11.4 0.07	12.2 0.11	12.6 0.15	12.5 0.20	12.0 0.23	11.2 0.24	10.5 0.23	10.0 0.20	10.0 0.15
65	RA DEC	18 53 -467	49.4 0.99	50.0 0.99	50.7 0.98	51.7 0.98	52.6 0.97	53.5 0.96	54.1 0.96	54.3 0.96	54.0 0.97	53.5 0.97	52.9 0.97	52.6 0.97	52.7 0.97
66	RA DEC	19 49 156	38.8 0.61	39.1 0.58	39.7 0.57	40.4 0.56	41.3 0.58	42.1 0.60	42.8 0.63	43.1 0.66	42.9 0.68	42.5 0.69	41.9 0.69	41.5 0.68	41.5 0.65
67	RA DEC	20 23 -1009	48.3 0.96	48.6 0.92	49.4 0.89	50.6 0.86	52.1 0.84	53.6 0.83	54.8 0.84	55.5 0.87	55.4 0.90	54.7 0.92	53.6 0.93	52.8 0.93	52.4 0.90
68	RA DEC	20 40 803	37.8 0.59	37.8 0.54	38.2 0.51	39.0 0.48	40.1 0.48	41.2 0.51	42.1 0.56	42.5 0.61	42.3 0.65	41.8 0.68	40.9 0.69	40.2 0.68	39.7 0.65
69	RA DEC	21 38 -1377	53.2 0.70	52.4 0.65	53.1 0.60	55.3 0.55	58.2 0.52	61.6 0.51	64.7 0.51	66.9 0.55	67.3 0.59	66.1 0.63	63.6 0.65	60.9 0.65	58.8 0.62
70	RA DEC	21 43 173	2.9 0.71	2.9 0.69	3.1 0.68	3.6 0.67	4.4 0.68	5.3 0.71	6.2 0.74	6.8 0.77	6.9 0.80	6.8 0.81	6.3 0.82	5.9 0.81	5.6 0.79
71	RA DEC	22 6 -836	46.3 0.88	46.1 0.86	46.3 0.82	46.9 0.79	47.9 0.75	49.1 0.72	50.3 0.72	51.3 0.72	51.6 0.75	51.4 0.78	50.8 0.80	50.1 0.81	49.6 0.80
72	RA DEC	22 56 -528	22.5 0.81	22.3 0.80	22.3 0.79	22.7 0.76	23.3 0.72	24.3 0.69	25.3 0.67	26.2 0.66	26.7 0.67	26.7 0.69	26.4 0.71	25.9 0.72	25.4 0.73
73	RA DEC	23 3 268	36.9 0.16	36.6 0.14	36.6 0.12	36.9 0.11	37.5 0.11	38.4 0.13	39.3 0.16	40.1 0.20	40.6 0.23	40.6 0.25	40.4 0.26	40.0 0.26	39.6 0.24

Table 11. Apparent Place of Polaris (Star No. 10), 1977
 Zero hours universal time (GMT) on 0, 10th, 20th, 30th Days of Month

	Declination				Right Ascension		
	°	'	"	m	h	m	s
JAN 0	89	9	51	1585.14	2	10	29
10			53	1585.15			16
20			53	1585.15			2
30			54	1585.15		9	47
FEB 0	89	9	54	1585.15	2	9	46
10			53	1585.15			31
20			52	1585.15			17
30			50	1585.14			5
MAR 0	89	9	51	1585.14	2	9	7
10			49	1585.13		8	56
20			46	1585.12			46
30			43	1585.10			40
APR 0	89	9	43	1585.10	2	8	40
10			40	1585.09			36
20			37	1585.07			35
30			33	1585.05			37
MAY 0	89	9	33	1585.05	2	8	37
10			31	1585.04			42
20			28	1585.03			49
30			25	1585.01			58
JUN 0	89	9	25	1585.01	2	8	59
10			23	1585.00		9	11
20			22	1585.00			24
30			21	1584.99			38
JUL 0	89	9	21	1584.99	2	9	38
10			20	1584.99			53
20			21	1584.99		10	8
30			21	1584.99			24
AUG 0	89	9	21	1584.99	2	10	25
10			22	1585.00			41
20			24	1585.01			55
30			26	1585.02		11	8
SEP 0	89	9	27	1585.02	2	11	10
10			29	1585.03			22
20			32	1585.05			33
30			35	1585.06			42
OCT 0	89	9	35	1585.06	2	11	42
10			39	1585.08			49
20			42	1585.10			55
30			46	1585.12			58
NOV 0	89	9	46	1585.12	2	11	58
10			50	1585.14			58
20			54	1585.16			55
30			57	1585.17			51
DEC 0	89	9	57	1585.17	2	11	51
10		10	0	1585.19			43
20			3	1585.20			34
30			5	1585.21			22
JAN 0	89	10	5	1585.21	2	11	21

TABLE 12
TO DETERMINE AZIMUTH FROM POLARIS

PURPOSE: The purpose of this table is to provide a fast, simple method of determining 5th order azimuths from observations of Polaris. When the appropriate secant table (following) is used, use of logarithms is unnecessary.

GUIDE FOR USE:

1. Determine Local Siderial Time (L.S.T.) of observation as described in FM 6-2.
2. Enter the table with this L.S.T. and extract the corresponding b_0 , b_1 , and b_2 .
3. Algebraically add b_0 , b_1 , and b_2 .
4. Select the appropriate secant table depending whether the results are to be in minutes of arc or mils. It is advisable to "X" out the secant table that will not be used. Using degrees of latitude, extract the corresponding secant and DIFF 1' OF LAT. ($\times 100000$). Round the minutes and seconds of latitude to the nearest whole minute; multiply this by the DIFF 1'; round to the nearest 10; move the decimal 5 places to the left; and add the result to the secant.
5. Multiply the result of 4. above by the sum of $b_0 + b_1 + b_2$ and round to the nearest 0.1; this, with the sign of $b_0 + b_1 + b_2$, is the azimuth angle.
6. Add the azimuth angle algebraically to 6400 mils (or 360 degrees) to get the azimuth to Polaris. Subtract the mean horizontal angle (clockwise, from azimuth mark to Polaris) from the azimuth to Polaris to get the azimuth to the mark. If the azimuth to the mark exceeds 6400, subtract 6400.

EXAMPLE: Required: Astronomic azimuth

Known: L.S.T. of observation = 5 hrs 27 min

Latitude = $34^{\circ} 37' 45''$

Month = May 1976

Mean horizontal angle from mark to Polaris = 1320.5 μ

From TABLE 12, 1976: $b_0 = -38.8$, $b_1 = +.2$, $b_2 = -.3$

$b_0 + b_1 + b_2 = (-38.8) + (+.2) + (-.3) = -38.9$

Results are needed in mils so the SECANT TABLE, Results in Mils is used.

DEGREES LATITUDE	SECANT ($\times \mu$ conv.)	DIFF. 1' OF LAT. ($\times 100000$)
34	0.3574	7.2

Minutes and seconds of latitude rounded to nearest whole minute = 38; $38 \times 7.2 = 273.6$; rounding to nearest 10 yields 270; moving the decimal 5 places to the left yields .0027; $0.3574 + .0027 = 0.3601$

$-38.9 \times 0.3601 = -14.00789$; rounded to the nearest 0.1 μ this yields AZIMUTH ANGLE = -14.0 μ

AZIMUTH TO MARK = -14.0 + 6400 - 1320.5 = 5065.5 μ

SECANT TABLE, Results in Mils

DEGREES LATITUDE	SECANT (X 100000)	DIFF. 1' OF LAT. (X 100000)	DEGREES LATITUDE	SECANT (X 100000)	DIFF. 1' OF LAT. (X 100000)	DEGREES LATITUDE	SECANT (X 100000)	DIFF. 1' OF LAT. (X 100000)
0	0.2963	0.1	23	0.3219	4.1	46	0.4265	13.2
1	0.2963	0.2	24	0.3243	4.3	47	0.4345	13.9
2	0.2965	0.4	25	0.3269	4.6	48	0.4428	14.7
3	0.2967	0.5	26	0.3297	4.8	49	0.4516	15.5
4	0.2970	0.7	27	0.3325	5.1	50	0.4610	16.4
5	0.2974	0.8	28	0.3356	5.3	51	0.4708	17.4
6	0.2979	1.0	29	0.3388	5.6	52	0.4813	18.5
7	0.2985	1.1	30	0.3421	5.9	53	0.4923	19.6
8	0.2992	1.3	31	0.3457	6.2	54	0.5041	20.8
9	0.3000	1.5	32	0.3494	6.5	55	0.5166	22.1
10	0.3009	1.6	33	0.3533	6.8	56	0.5299	23.6
11	0.3018	1.8	34	0.3574	7.2	57	0.5440	25.2
12	0.3029	2.0	35	0.3617	7.6	58	0.5591	26.9
13	0.3041	2.1	36	0.3662	7.9	59	0.5753	28.8
14	0.3054	2.3	37	0.3710	8.3	60	0.5926	30.9
15	0.3067	2.5	38	0.3760	8.8	61	0.6112	33.3
16	0.3082	2.7	39	0.3813	9.2	62	0.6311	35.9
17	0.3098	2.8	40	0.3868	9.7	63	0.6526	38.8
18	0.3115	3.0	41	0.3926	10.2	64	0.6759	42.0
19	0.3134	3.2	42	0.3987	10.7	65	0.7011	45.6
20	0.3153	3.4	43	0.4051	11.3	66	0.7285	49.7
21	0.3174	3.6	44	0.4119	11.9	67	0.7583	
22	0.3196	3.9	45	0.4190	12.5			

SECANT TABLE, Results in Minutes of Arc

DEGREES LATITUDE	NATURAL SECANT	DIFF. 1' OF LAT. (X 100000)	DEGREES LATITUDE	NATURAL SECANT	DIFF. 1' OF LAT. (X 100000)	DEGREES LATITUDE	NATURAL SECANT	DIFF. 1' OF LAT. (X 100000)
0	1.000	0.	23	1.086	14.	46	1.440	45.
1	1.000	1.	24	1.095	15.	47	1.466	47.
2	1.001	1.	25	1.103	15.	48	1.494	50.
3	1.001	2.	26	1.113	16.	49	1.524	52.
4	1.002	2.	27	1.122	17.	50	1.556	55.
5	1.004	3.	28	1.133	18.	51	1.589	59.
6	1.006	3.	29	1.143	19.	52	1.624	62.
7	1.008	4.	30	1.155	20.	53	1.662	66.
8	1.010	4.	31	1.167	21.	54	1.701	70.
9	1.012	5.	32	1.179	22.	55	1.743	75.
10	1.015	5.	33	1.192	23.	56	1.788	80.
11	1.019	6.	34	1.206	24.	57	1.836	85.
12	1.022	7.	35	1.221	25.	58	1.887	91.
13	1.026	7.	36	1.236	27.	59	1.942	97.
14	1.031	8.	37	1.252	28.	60	2.000	104.
15	1.035	8.	38	1.269	30.	61	2.063	112.
16	1.040	9.	39	1.287	31.	62	2.130	121.
17	1.046	10.	40	1.305	33.	63	2.203	131.
18	1.051	10.	41	1.325	34.	64	2.281	142.
19	1.058	11.	42	1.346	36.	65	2.366	154.
20	1.064	12.	43	1.367	38.	66	2.459	168.
21	1.071	12.	44	1.390	40.	67	2.559	
22	1.079	13.	45	1.414	42.			

TABLE 12. TO DETERMINE AZIMUTH FROM POLARIS, 1977

L.S.T.	0 ^h	1 ^h	2 ^h	3 ^h	4 ^h	5 ^h	6 ^h	7 ^h	8 ^h	9 ^h	10 ^h	11 ^h
	<i>b</i> ₀	<i>b</i> ₀	<i>b</i> ₀	<i>b</i> ₀	<i>b</i> ₀	<i>b</i> ₀	<i>b</i> ₀	<i>b</i> ₀	<i>b</i> ₀	<i>b</i> ₀	<i>b</i> ₀	<i>b</i> ₀
m												
0												
3	27.3	15.2	2.1	-11.3	-23.8	-34.6	-43.0	-48.3	-50.3	-48.9	-44.2	-36.5
6	26.7	14.6	1.4	-12.0	-24.4	-35.1	-43.3	-48.5	-50.4	-48.8	-43.9	-36.1
9	26.2	13.9	0.7	-12.6	-25.0	-35.6	-43.7	-48.7	-50.4	-48.6	-43.6	-35.6
12	25.6	13.3	0.0	-13.3	-25.6	-36.1	-44.0	-48.9	-50.4	-48.4	-43.2	-35.2
	25.0	12.6	-0.7	-13.9	-26.2	-36.5	-44.3	-49.0	-50.3	-48.2	-42.9	-34.7
15												
18	24.4	12.0	-1.4	-14.6	-26.7	-37.0	-44.6	-49.2	-50.3	-48.0	-42.5	-34.2
21	23.8	11.3	-2.1	-15.2	-27.3	-37.4	-44.9	-49.3	-50.3	-47.8	-42.2	-33.8
24	23.2	10.7	-2.7	-15.9	-27.8	-37.9	-45.2	-49.4	-50.2	-47.6	-41.8	-33.3
27	22.6	10.0	-3.4	-16.5	-28.4	-38.3	-45.5	-49.6	-50.2	-47.4	-41.5	-32.8
	22.0	9.4	-4.1	-17.1	-28.9	-38.7	-45.8	-49.7	-50.1	-47.2	-41.1	-32.3
30												
33	21.4	8.7	-4.7	-17.7	-29.5	-39.2	-46.1	-49.8	-50.1	-47.0	-40.7	-31.8
36	20.8	8.1	-5.4	-18.4	-30.0	-39.6	-46.3	-49.9	-50.0	-46.7	-40.3	-31.3
39	20.2	7.4	-6.1	-19.0	-30.6	-40.0	-46.6	-50.0	-49.9	-46.5	-39.9	-30.8
42	19.6	6.7	-6.7	-19.6	-31.1	-40.4	-46.8	-50.0	-49.8	-46.2	-39.5	-30.2
	19.0	6.1	-7.4	-20.2	-31.6	-40.8	-47.1	-50.1	-49.7	-45.9	-39.1	-29.7
45												
48	18.4	5.4	-8.1	-20.8	-32.1	-41.2	-47.3	-50.2	-49.6	-45.7	-38.7	-29.2
51	17.7	4.7	-8.7	-21.4	-32.6	-41.5	-47.5	-50.2	-49.5	-45.4	-38.3	-28.7
54	17.1	4.1	-9.4	-22.0	-33.2	-41.9	-47.7	-50.3	-49.4	-45.1	-37.9	-28.1
57	16.5	3.4	-10.0	-22.6	-33.6	-42.3	-47.9	-50.3	-49.2	-44.8	-37.4	-27.6
	15.9	2.7	-10.7	-23.2	-34.1	-42.6	-48.1	-50.3	-49.1	-44.5	-37.0	-27.0
60												
	15.2	2.1	-11.3	-23.8	-34.6	-43.0	-48.3	-50.3	-48.9	-44.2	-36.5	-26.5
Lat.	<i>b</i> ₁	<i>b</i> ₁	<i>b</i> ₁	<i>b</i> ₁	<i>b</i> ₁	<i>b</i> ₁	<i>b</i> ₁	<i>b</i> ₁	<i>b</i> ₁	<i>b</i> ₁	<i>b</i> ₁	<i>b</i> ₁
°												
0												
10	-0.2	0.0	0.2	0.4	0.4	0.4	0.2	0.0	-0.2	-0.4	-0.4	-0.4
20	-0.2	0.0	0.2	0.3	0.4	0.3	0.2	0.0	-0.2	-0.3	-0.4	-0.3
30	-0.2	0.0	0.1	0.3	0.3	0.3	0.2	0.0	-0.1	-0.3	-0.3	-0.3
	-0.1	0.0	0.1	0.2	0.2	0.2	0.1	0.0	-0.1	-0.2	-0.2	-0.2
40	-0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.0	-0.1	-0.1	-0.1	-0.1
45	-0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	-0.1	-0.1	-0.1
50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
55	0.0	0.0	0.0	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.1	0.1	0.1
60	0.1	0.0	-0.1	-0.2	-0.2	-0.2	-0.1	0.0	0.1	0.2	0.2	0.2
62	0.1	0.0	-0.1	-0.2	-0.2	-0.2	-0.1	0.0	0.1	0.2	0.2	0.2
64	0.2	0.0	-0.1	-0.3	-0.3	-0.3	-0.2	0.0	0.1	0.3	0.3	0.3
66	0.2	0.0	-0.2	-0.3	-0.4	-0.4	-0.2	0.0	0.2	0.3	0.4	0.4
Month	<i>b</i> ₂	<i>b</i> ₂	<i>b</i> ₂	<i>b</i> ₂	<i>b</i> ₂	<i>b</i> ₂	<i>b</i> ₂	<i>b</i> ₂	<i>b</i> ₂	<i>b</i> ₂	<i>b</i> ₂	<i>b</i> ₂
JAN	0.1	0.2	0.2	0.3	0.3	0.3	0.3	0.2	0.2	0.1	0.0	0.0
FEB	0.0	0.0	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1
MAR	-0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1
APR	0.0	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.0	-0.0	-0.0
MAY	0.1	0.0	0.0	-0.1	-0.1	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.1
JUN	0.2	0.2	0.1	0.0	-0.1	-0.2	-0.2	-0.3	-0.3	-0.3	-0.3	-0.3
JUL	0.4	0.3	0.2	0.1	0.0	-0.1	-0.2	-0.3	-0.3	-0.4	-0.4	-0.4
AUG	0.5	0.5	0.4	0.3	0.2	0.1	0.0	-0.2	-0.3	-0.4	-0.4	-0.5
SEP	0.5	0.6	0.5	0.5	0.4	0.3	0.1	0.0	-0.2	-0.3	-0.4	-0.5
OCT	0.5	0.6	0.6	0.6	0.5	0.4	0.3	0.2	0.0	-0.2	-0.3	-0.4
NOV	0.4	0.6	0.6	0.7	0.6	0.6	0.5	0.3	0.2	0.0	-0.1	-0.3
DEC	0.3	0.4	0.6	0.6	0.7	0.6	0.6	0.5	0.3	0.2	0.0	-0.1

$$\text{AZIMUTH OF POLARIS} = \frac{(b_0 + b_1 + b_2)}{\cos \text{LATITUDE}}$$

TABLE 12. TO DETERMINE AZIMUTH FROM POLARIS, 1977 - CONTINUED

L.S.T.	12 ^h	13 ^h	14 ^h	15 ^h	16 ^h	17 ^h	18 ^h	19 ^h	20 ^h	21 ^h	22 ^h	23 ^h
	<i>b</i> ₀	<i>b</i> ₀	<i>b</i> ₀	<i>b</i> ₀	<i>b</i> ₀	<i>b</i> ₀	<i>b</i> ₀	<i>b</i> ₀	<i>b</i> ₀	<i>b</i> ₀	<i>b</i> ₀	<i>b</i> ₀
m												
0	-26.5	-14.7	-2.0	11.0	23.1	33.8	42.2	47.8	50.3	49.3	44.9	37.4
3	-25.9	-14.1	-1.3	11.6	23.7	34.2	42.5	48.0	50.3	49.2	44.6	37.0
6	-25.4	-13.5	-0.7	12.2	24.3	34.7	42.9	48.2	50.3	49.0	44.3	36.5
9	-24.8	-12.8	0.1	12.8	24.8	35.2	43.2	48.4	50.4	48.9	44.0	36.1
12	-24.3	-12.2	0.7	13.5	25.4	35.6	43.6	48.6	50.4	48.7	43.7	35.6
15	-23.7	-11.6	1.3	14.1	25.9	36.1	43.9	48.8	50.4	48.5	43.3	35.1
18	-23.1	-11.0	2.0	14.7	26.5	36.5	44.2	48.9	50.3	48.3	43.0	34.6
21	-22.5	-10.3	2.6	15.3	27.0	37.0	44.5	49.1	50.3	48.1	42.6	34.1
24	-21.9	-9.7	3.3	16.0	27.6	37.4	44.8	49.2	50.3	47.9	42.3	33.6
27	-21.4	-9.1	3.9	16.6	28.1	37.9	45.1	49.4	50.3	47.7	41.9	33.2
30	-20.8	-8.4	4.6	17.2	28.7	38.3	45.4	49.5	50.2	47.5	41.5	32.6
33	-20.2	-7.8	5.2	17.8	29.2	38.7	45.7	49.6	50.2	47.3	41.2	32.1
36	-19.6	-7.1	5.9	18.4	29.7	39.1	45.9	49.7	50.1	47.1	40.8	31.6
39	-19.0	-6.5	6.5	19.0	30.2	39.5	46.2	49.8	50.0	46.8	40.4	31.1
42	-18.4	-5.9	7.1	19.6	30.8	39.9	46.5	49.9	50.0	46.6	40.0	30.6
45	-17.8	-5.2	7.8	20.2	31.3	40.3	46.7	50.0	49.9	46.3	39.6	30.0
48	-17.2	-4.6	8.4	20.8	31.8	40.7	47.0	50.1	49.8	46.1	39.2	29.5
51	-16.6	-3.9	9.1	21.4	32.3	41.1	47.2	50.1	49.7	45.9	38.7	28.9
54	-16.0	-3.3	9.7	21.9	32.8	41.5	47.4	50.2	49.6	45.7	38.3	28.4
57	-15.3	-2.6	10.3	22.5	33.3	41.8	47.6	50.2	49.4	45.2	37.9	27.8
60	-14.7	-2.0	11.0	23.1	33.8	42.2	47.8	50.3	49.3	44.9	37.4	27.3
Lat.	<i>b</i> ₁	<i>b</i> ₁	<i>b</i> ₁	<i>b</i> ₁	<i>b</i> ₁	<i>b</i> ₁	<i>b</i> ₁	<i>b</i> ₁	<i>b</i> ₁	<i>b</i> ₁	<i>b</i> ₁	<i>b</i> ₁
0												
10	-0.2	0.0	0.2	0.4	0.4	0.4	0.2	0.0	-0.2	-0.4	-0.4	-0.4
20	-0.2	0.0	0.2	0.3	0.4	0.3	0.2	0.0	-0.2	-0.3	-0.4	-0.3
30	-0.1	0.0	0.1	0.2	0.3	0.3	0.2	0.0	-0.1	-0.3	-0.3	-0.2
40	-0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.0	-0.1	-0.1	-0.1	-0.1
45	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	-0.1	-0.1	-0.1	-0.1
50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
55	0.0	0.0	0.0	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.1	0.1	0.1
60	0.1	0.0	-0.1	-0.2	-0.2	-0.2	-0.1	0.0	0.1	0.2	0.2	0.2
62	0.1	0.0	-0.1	-0.2	-0.3	-0.3	-0.1	0.0	0.1	0.2	0.3	0.2
64	0.2	0.0	-0.1	-0.3	-0.3	-0.3	-0.2	0.0	0.1	0.3	0.3	0.3
66	0.2	0.0	-0.2	-0.3	-0.4	-0.4	-0.2	0.0	0.2	0.3	0.4	0.4
Month	<i>b</i> ₂	<i>b</i> ₂	<i>b</i> ₂	<i>b</i> ₂	<i>b</i> ₂	<i>b</i> ₂	<i>b</i> ₂	<i>b</i> ₂	<i>b</i> ₂	<i>b</i> ₂	<i>b</i> ₂	<i>b</i> ₂
JAN	-0.1	-0.2	-0.2	-0.3	-0.3	-0.3	-0.3	-0.2	-0.2	-0.1	0.0	0.0
FEB	0.0	0.0	-0.1	-0.1	-0.2	-0.2	-0.2	-0.2	-0.2	-0.1	-0.1	-0.1
MAR	0.1	0.0	0.0	0.0	-0.0	0.0	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1
APR	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0
MAY	-0.1	0.0	0.0	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.1
JUN	-0.2	-0.2	-0.1	0.0	0.1	0.2	0.2	0.3	0.3	0.3	0.3	0.3
JUL	-0.4	-0.3	-0.2	-0.1	0.0	0.1	0.2	0.3	0.3	0.4	0.4	0.4
AUG	-0.5	-0.5	-0.4	-0.3	-0.2	-0.1	0.0	0.2	0.3	0.4	0.4	0.5
SEP	-0.5	-0.6	-0.5	-0.5	-0.4	-0.3	-0.1	0.0	0.2	0.3	0.4	0.5
OCT	-0.5	-0.6	-0.6	-0.6	-0.5	-0.4	-0.3	-0.2	-0.0	0.2	0.3	0.4
NOV	-0.4	-0.6	-0.6	-0.7	-0.6	-0.6	-0.5	-0.3	-0.2	0.0	0.1	0.3
DEC	-0.3	-0.4	-0.6	-0.6	-0.7	-0.6	-0.6	-0.5	-0.3	-0.2	0.0	0.1

$$\text{AZIMUTH OF POLARIS} = \frac{(b_0 + b_1 + b_2)}{\cos \text{LATITUDE}}$$

TABLE 13. Grid Azimuth Correction, Simultaneous Observation

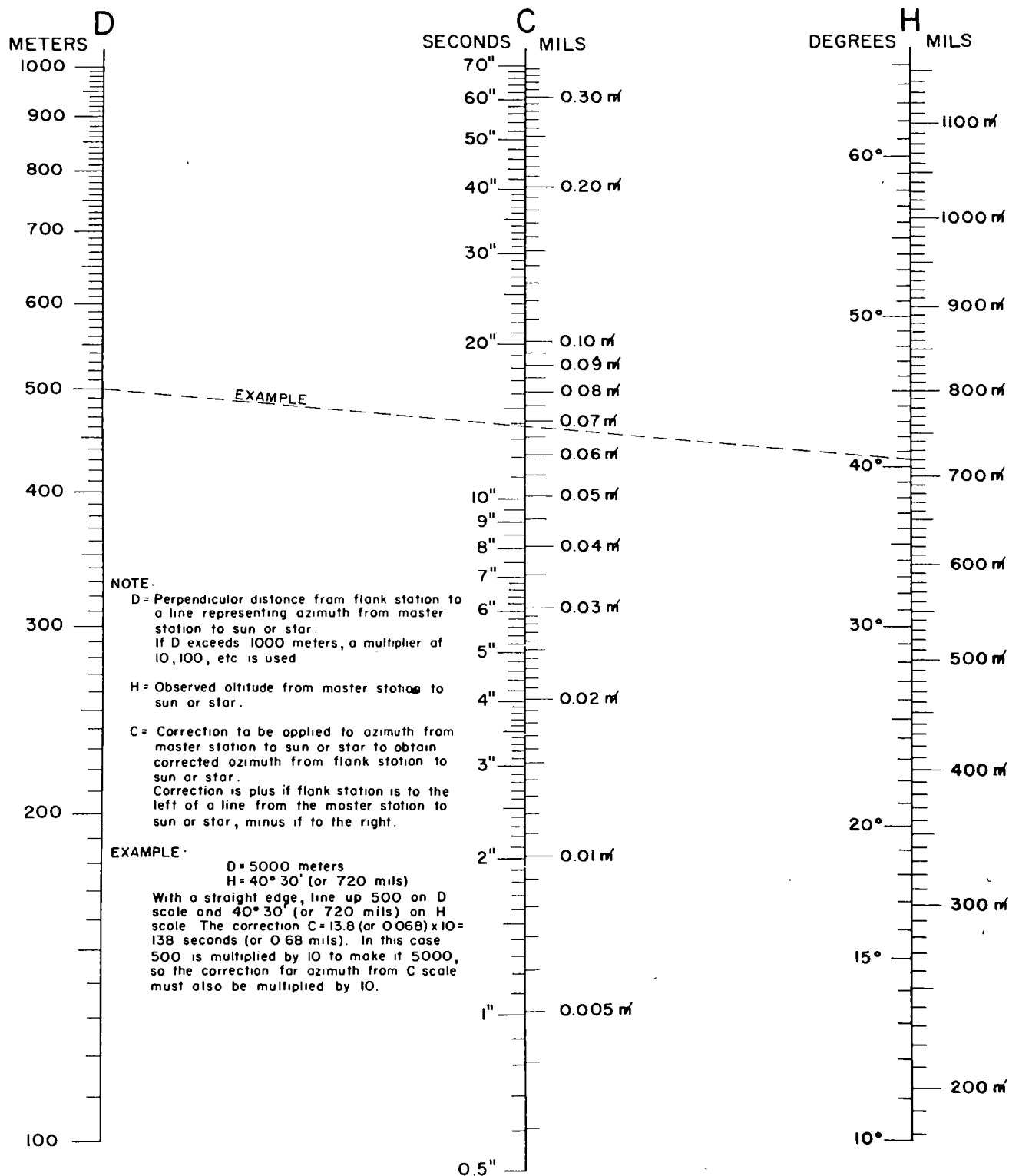


TABLE 14

ZONE TO ZONE AZIMUTH TRANSFORMATION TABLE

PURPOSE: The purpose of this table is to provide a method for the conversion of UTM grid azimuths in one zone into the corresponding azimuths at an adjacent zone. The table is designed for use in the area between the respective central meridians of the adjacent zones; however, it will yield accurate results a moderate distance outside this area. Results are in mils.

GUIDE FOR USE:

1. Coordinates must be transformed to the adjacent zone by use of TM 5-241-2 or other means.
2. The northing coordinates in each zone are added together. This "total northing" (N) is rounded to the nearest 100 (4th order) or 1000 (5th order). In the Southern Hemisphere the total N must be subtracted from 20,000,000 before entering the table.
3. Find the tabulated N's between which the total N lies, subtract the lower tabulated N from the total N and move the decimal 5 places to the left.
4. Multiply this by the "DIFF IN C" located opposite the lower tabulated N.
5. Add this product to the "C" opposite the lower tabulated value. In 5th order computations this is the change in azimuth; 4th order accuracy requires the following steps.
6. Subtract the smaller of the 2 N's of the point from the larger, round to the nearest 100, and move the decimal 3 places to the left. If the resulting number is smaller than the "ALLOWABLE DIFF IN N" opposite the lower tabulated N no further computations are required and the result from 5 above is the correct change in azimuth. If it is larger, complete the following steps.
7. Square the computed number.
8. Extract from the table the F closest the total N, multiply it by the squared number, round to nearest whole number and move the decimal 3 places to the left.
9. Add the resulting number to the result of 5 above. The sum is the change in azimuth.
10. The sign of the change in azimuth is determined by use of the following chart:

When the point is transformed from:

(Northern Hemisphere)

East to West, sign is -
West to East, sign is +

(Southern Hemisphere)

East to West, sign is +
West to East, sign is -

EXAMPLE: (5th ORDER ACCURACY)

Required: Change in azimuth (C) to nearest 0.1 μ .

Known: N (Zone 15) = 3833384

N (Zone 14) = 3830861

$3833384 + 3830861 = 7664245$; round to 7664000 which lies between 7600000 and 7700000 in the table.

$7664000 - 7600000 = 64000$; moving the decimal 5 places to the left yields 0.64

N	C	DIFF IN C
7 600 000	60.157	.691

$C = 60.157 + (0.64 \times .691) = 60.157 + .442 = 60.599$

Rounded to the nearest 0.1 μ , $C = 60.6 \mu$

EXAMPLE: (4th ORDER ACCURACY)

Required: Change in azimuth (C) to nearest 0.001 μ .

Known: N (Zone 15) = 3834767

N (Zone 14) = 3830679

$3834767 + 3830679 = 7665446$; round to 7665400 which lies between 7600000 and 7700000 in the table.

$7665400 - 7600000 = 65400$; moving the decimal 5 places to the left yields 0.654

N	C	DIFF IN C	ALLOWABLE DIFF IN N	F
7 600 000	60.157	.691	1.53	0.21
7 700 000			1.54	0.21

$C = 60.157 + (0.654 \times .691) = 60.157 + .452 = 60.609 \mu$

$3834767 - 3830679 = 4088$; rounding to the nearest 100 and moving the decimal 3 places to the left yields 4.1 which is larger than the closest ALLOWABLE DIFF IN N (1.54). Therefore, further computations are required.

$4.1 \text{ squared} = 4.1 \times 4.1 = 16.8$; $16.8 \times F = 16.8 \times 0.21 = 3.53$; rounding to the nearest whole number and moving the decimal 3 places to the left yields .004

$C = 60.609 + .004 = \underline{60.613 \mu}$

N		C	DIFF IN C	ALLOWABLE DIFF IN N	F
	0	0.0	.842	★	★
	100 000	0.842	.842	0.18	15.24
	200 000	1.684	.841	0.26	7.62
	300 000	2.525	.842	0.31	5.08
	400 000	3.367	.841	0.36	3.81
	500 000	4.208	.841	0.40	3.05
	600 000	5.049	.841	0.44	2.54
	700 000	5.890	.840	0.48	2.18
	800 000	6.730	.840	0.51	1.91
	900 000	7.570	.840	0.54	1.70
1	000 000	8.410	.838	0.57	1.53
1	100 000	9.248	.839	0.60	1.39
1	200 000	10.087	.837	0.63	1.27
1	300 000	10.924	.837	0.65	1.18
1	400 000	11.761	.837	0.68	1.09
1	500 000	12.598	.835	0.70	1.02
1	600 000	13.433	.835	0.72	0.96
1	700 000	14.268	.833	0.75	0.90
1	800 000	15.101	.833	0.77	0.85
1	900 000	15.934	.832	0.79	0.81
2	000 000	16.766	.830	0.81	0.77
2	100 000	17.596	.830	0.83	0.73
2	200 000	18.426	.828	0.85	0.70
2	300 000	19.254	.827	0.87	0.67
2	400 000	20.081	.826	0.88	0.64
2	500 000	20.907	.825	0.90	0.61
2	600 000	21.732	.823	0.92	0.59
2	700 000	22.555	.822	0.94	0.57
2	800 000	23.377	.820	0.95	0.55
2	900 000	24.197	.819	0.97	0.53
3	000 000	25.016	.817	0.99	0.51
3	100 000	25.833	.815	1.00	0.50
3	200 000	26.648	.814	1.02	0.48
3	300 000	27.462	.812	1.03	0.47
3	400 000	28.274	.810	1.05	0.45
3	500 000	29.084	.809	1.06	0.44
3	600 000	29.893	.806	1.08	0.43
3	700 000	30.699	.805	1.09	0.42
3	800 000	31.504	.803	1.11	0.41
3	900 000	32.307	.800	1.12	0.40
4	000 000	33.107	.799	1.14	0.39
4	100 000	33.906	.796	1.15	0.38
4	200 000	34.702	.794	1.16	0.37
4	300 000	35.496	.792	1.18	0.36
4	400 000	36.288	.790	1.19	0.35
4	500 000	37.078	.787	1.20	0.35
4	600 000	37.865	.785	1.22	0.34
4	700 000	38.650	.782	1.23	0.33
4	800 000	39.432	.780	1.24	0.33
4	900 000	40.212	.778	1.25	0.32
5	000 000	40.990	.774	1.26	0.31
5	100 000	41.764	.773	1.28	0.31
5	200 000	42.537	.769	1.29	0.30
5	300 000	43.306	.767	1.30	0.30
5	400 000	44.073	.764	1.31	0.29
5	500 000	44.837	.761	1.32	0.29
5	600 000	45.598	.758	1.33	0.28
5	700 000	46.356	.756	1.35	0.28
5	800 000	47.112	.752	1.36	0.27
5	900 000	47.864	.750	1.37	0.27

★ F CORRECTION NOT REQUIRED

ALLOWABLE
DIFF IN N

N	C	DIFF IN C	ALLOWABLE DIFF IN N	F
6 000 000	48.614	.746	1.38	0.26
6 100 000	49.360	.743	1.39	0.26
6 200 000	50.103	.740	1.40	0.26
6 300 000	50.843	.737	1.41	0.25
6 400 000	51.580	.734	1.42	0.25
6 500 000	52.314	.730	1.43	0.25
6 600 000	53.044	.727	1.44	0.24
6 700 000	53.771	.724	1.45	0.24
6 800 000	54.495	.720	1.46	0.24
6 900 000	55.215	.717	1.47	0.23
7 000 000	55.932	.713	1.48	0.23
7 100 000	56.645	.710	1.49	0.23
7 200 000	57.355	.706	1.50	0.22
7 300 000	58.061	.702	1.51	0.22
7 400 000	58.763	.699	1.52	0.22
7 500 000	59.462	.695	1.52	0.22
7 600 000	60.157	.691	1.53	0.21
7 700 000	60.848	.688	1.54	0.21
7 800 000	61.536	.683	1.55	0.21
7 900 000	62.219	.680	1.56	0.21
8 000 000	62.899	.675	1.57	0.20
8 100 000	63.574	.672	1.58	0.20
8 200 000	64.246	.668	1.59	0.20
8 300 000	64.914	.664	1.59	0.20
8 400 000	65.578	.659	1.60	0.20
8 500 000	66.237	.656	1.61	0.19
8 600 000	66.893	.651	1.62	0.19
8 700 000	67.544	.647	1.63	0.19
8 800 000	68.191	.643	1.63	0.19
8 900 000	68.834	.638	1.64	0.19
9 000 000	69.472	.634	1.65	0.18
9 100 000	70.106	.630	1.66	0.18
9 200 000	70.736	.625	1.66	0.18
9 300 000	71.361	.621	1.67	0.18
9 400 000	71.982	.616	1.68	0.18
9 500 000	72.598	.612	1.69	0.18
9 600 000	73.210	.608	1.69	0.17
9 700 000	73.818	.602	1.70	0.17
9 800 000	74.420	.598	1.71	0.17
9 900 000	75.018	.594	1.71	0.17
10 000 000	75.612	.588	1.72	0.17
10 100 000	76.200	.584	1.73	0.17
10 200 000	76.784	.579	1.74	0.17
10 300 000	77.363	.575	1.74	0.17
10 400 000	77.938	.569	1.75	0.16
10 500 000	78.507	.565	1.75	0.16
10 600 000	79.072	.560	1.76	0.16
10 700 000	79.632	.554	1.77	0.16
10 800 000	80.186	.550	1.77	0.16
10 900 000	80.736	.545	1.78	0.16
11 000 000	81.281	.539	1.79	0.16
11 100 000	81.820	.535	1.79	0.16
11 200 000	82.355	.530	1.80	0.16
11 300 000	82.885	.524	1.80	0.15
11 400 000	83.409	.519	1.81	0.15
11 500 000	83.928	.514	1.82	0.15
11 600 000	84.442	.509	1.82	0.15
11 700 000	84.951	.503	1.83	0.15
11 800 000	85.454	.498	1.83	0.15
11 900 000	85.952	.493	1.84	0.15
12 000 000	86.445	.488	1.84	0.15

N		C	DIFF IN C	ALLOWABLE DIFF IN N	F
12	100 000	86.933	.482	1.85	0.15
12	200 000	87.415	.477	1.85	0.15
12	300 000	87.892	.471	1.86	0.15
12	400 000	88.363	.466	1.86	0.14
12	500 000	88.829	.460	1.87	0.14
12	600 000	89.289	.455	1.87	0.14
12	700 000	89.744	.449	1.88	0.14
12	800 000	90.193	.444	1.88	0.14
12	900 000	90.637	.438	1.89	0.14
13	000 000	91.075	.432	1.89	0.14
13	100 000	91.507	.427	1.90	0.14
13	200 000	91.934	.421	1.90	0.14
13	300 000	92.355	.416	1.91	0.14
13	400 000	92.771	.409	1.91	0.14
13	500 000	93.180	.404	1.91	0.14
13	600 000	93.584	.399	1.92	0.14
13	700 000	93.983	.392	1.92	0.14
13	800 000	94.375	.386	1.93	0.14
13	900 000	94.761	.381	1.93	0.13
14	000 000	95.142	.375	1.94	0.13
14	100 000	95.517	.369	1.94	0.13
14	200 000	95.886	.363	1.94	0.13
14	300 000	96.249	.357	1.95	0.13
14	400 000	96.606	.352	1.95	0.13
14	500 000	96.958	.345	1.95	0.13
14	600 000	97.303	.339	1.96	0.13
14	700 000	97.642	.333	1.96	0.13
14	800 000	97.975	.328	1.96	0.13
14	900 000	98.303	.321	1.97	0.13
15	000 000	98.624	.315	1.97	0.13
15	100 000	98.939	.309	1.97	0.13
15	200 000	99.248	.303	1.98	0.13
15	300 000	99.551	.297	1.98	0.13
15	400 000	99.848	.290	1.98	0.13
15	500 000	100.138	.285	1.99	0.13
15	600 000	100.423	.278	1.99	0.13
15	700 000	100.701	.273	1.99	0.13
15	800 000	100.974	.266	1.99	0.13
15	900 000	101.240	.259	2.00	0.13
16	000 000	101.499	.254	2.00	0.13
16	100 000	101.753	.247	2.00	0.13
16	200 000	102.000	.241	2.00	0.12
16	300 000	102.241	.235	2.01	0.12
16	400 000	102.476	.229	2.01	0.12
16	500 000	102.705	.222	2.01	0.12
16	600 000	102.927	.216	2.01	0.12
16	700 000	103.143	.209	2.02	0.12
16	800 000	103.352	.204	2.02	0.12
16	900 000	103.556	.196	2.02	0.12
17	000 000	103.752	.191	2.02	0.12
17	100 000	103.943	.184	2.02	0.12
17	200 000	104.127	.178	2.03	0.12
17	300 000	104.305	.171	2.03	0.12
17	400 000	104.476	.165	2.03	0.12
17	500 000	104.641	.159	2.03	0.12
17	600 000	104.800	.152	2.03	0.12
17	700 000	104.952	.146	2.03	0.12
17	800 000	105.098	.139	2.04	0.12
17	900 000	105.237	.133	2.04	0.12
18	000 000	105.370		2.04	0.12

By Order of the Secretary of the Army:

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General, United States Army
Chief of Staff

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